The Electrical Industry's Weekly Magazine August 14, 1961

Electrical World

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A McGraw-Hill Publication

How OG&E Teams Steam and Gas Turbines

...p72

Horseshoe Lake Station

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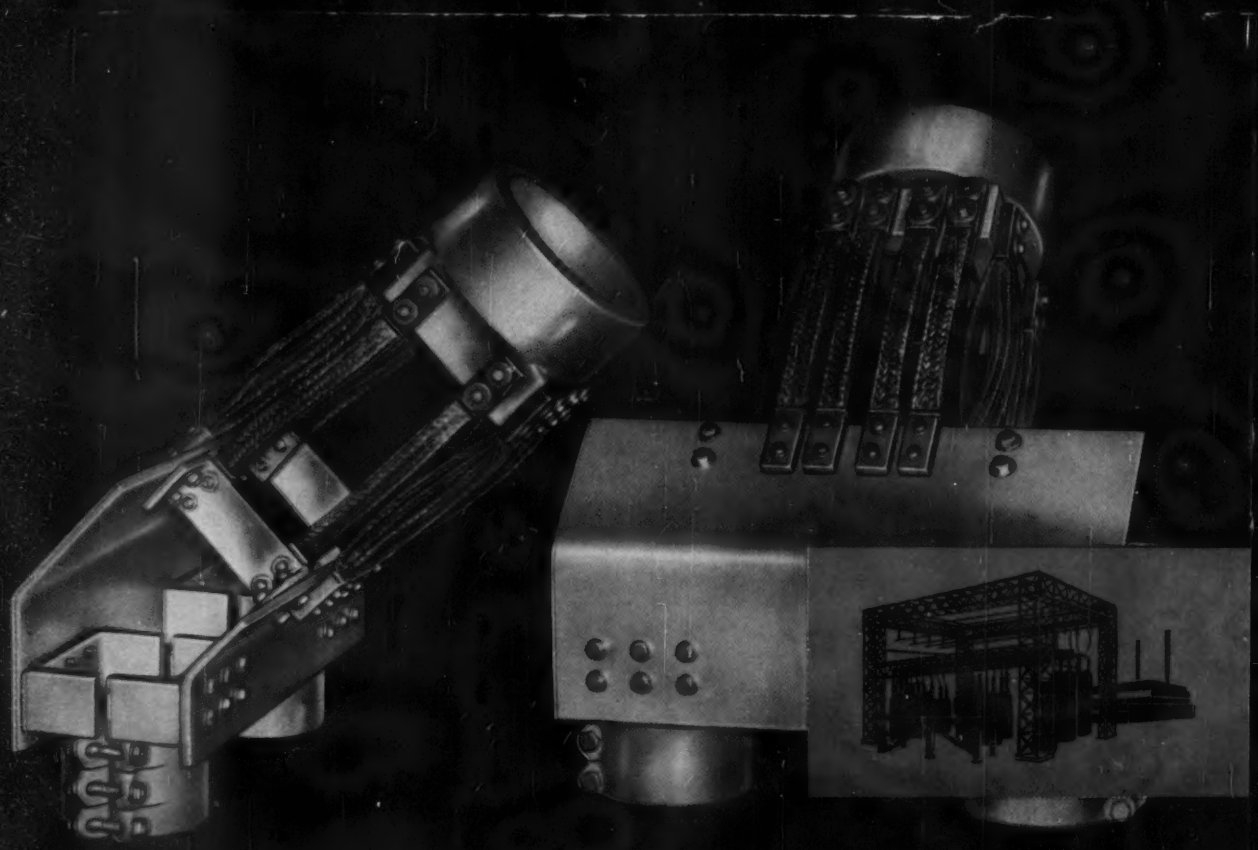

Where standard connectors can't do the job, Burndy designs "specials." Shown here is one of three Burndy connectors designed to save 100 lbs. each in weight. Linking aluminum bus to copper studs of 220,000 kva transformer, connectors are flexible, have 45° angle so stud portion can be swung aside when necessary.

BURNDY DESIGN

concentrates

ON DEVELOPING BETTER ELECTRICAL CONNECTIONS

From generator bus to service drop, the transmission and distribution of electricity depend on the design of the millions of electrical connectors that tie the system together. The design of Burndy connectors is based on 35 years experience with utility practices and with the electrical and mechanical design principles essential to produce dependable electrical connectors.

Burndy has concentrated its extensive design, research, test and production facilities on the development of better electrical connectors, standard as well as special. This unique concentration on the single objective of designing electrical connectors has produced a vast array of special connectors, like the transformer terminal unit illustrated, and whole families of mechanical and compression connectors that simplify the lineman's job, copper-to-aluminum connectors, and low cost connectors for use in great quantities.

DESIGN, RESEARCH, TEST AND PRODUCTION LEADERSHIP

BURNDY

58-17

Norwalk, Connect. In Europe: Antwerp, Belgium Toronto, Canada

Published for 87 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

August 14, 1961
Vol. 156, No. 7

Dateline . . .

Sam Houston Co-op Views Rural Redevelopment

Livingston, Texas—The Area Development Act passed in May of this year may look like a political hodge-podge in Washington, but it looks like a solid piece of business legislation out in some of the rural areas where it may be applied.

To get an idea of the possible consequences of this Act, which makes available some $100 million for loans to business in rural areas, we called on Milton T. Potts, manager of the Sam Houston Electric Cooperative near Livingston, Texas. Potts is respected as a business-like co-op manager, a hard bargainer on power contracts, and generally alert to new business opportunities for his co-op.

"There's a possibility that the redevelopment law can give us a hand down here," Potts told us, "and we've been giving it some thought." The board of directors of the Sam Houston Co-op acted earlier this year to budget several thousand dollars to initiate an area development program in its territory.

It is Potts' idea that he will hire a trained man to begin the preliminary work—survey the area's present resources and determine what possibilities exist for creating business enterprises that will bolster the economy of the area.

Potts will go at the job in a deliberate and business-like manner, seeking cooperation of and offering his services to other groups and organizations which will work on the program. If a car is needed to carry on the work, the cooperative will be glad to make a car available. If office space is needed, the cooperative will probably be able to share its space. Potts and the directors of the Sam Houston Cooperative look upon the redevelopment program as a neighborly undertaking that stands to help the community generally.

He lets you know that he thinks any federal loan funds should be handled just as carefully and in the same business-like manner that his own co-op has handled its loans from the Rural Electrification Administration. But he can see opportunities here and there where loans at reasonable interest rates might mean the difference between starting a new rural enterprise and not starting one.

(*Continued on page 5*)

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In thousands of schools across America, youngsters are learning about the important role that light plays in our daily lives. And this story of light is really hitting home—because the kids are taking it home . . . telling it and selling it to their parents.

Who's responsible for this valuable sequence of events? 121 utility companies who sponsor CTAP: Better Light Better Sight Bureau's Cooperative Teaching Aid Plan. By promoting CTAP, these utilities help enlighten today's market—and tomorrow's. By footing the bill for a highly useful series of teaching aids, they contribute toward better education, build better public relations, expand their service to their own communities, create better informed customers.

CTAP sponsors will tell you that educational assistance pays off consistently with tangible gains. In fact, whenever industry and education work hand-in-hand, *everybody* benefits.

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SERVING THE COMMUNITY THROUGH EDUCATION

Dateline . . .

Livingston, Texas (*Continued from page* 3)

"Let me give you some idea of what I mean," Potts said as we climbed into his car just outside his co-op office. We rode along the straight Texas roads to a town just outside his service area.

There, in a relatively small rural town, he pointed out a ceramic tile plant, a busy saw mill, and not very far away, a small plant turning out trailer homes. All of these were relatively small enterprises drawing on the local labor supply. The business section of the town was neat and there were customers even during the hot afternoon.

"You see," Potts related, "that bank over there has a progressive management. The men there try to understand local business problems and provide the capital that is needed to bring business into this town and keep it going. That's why this town is a bustling one and some of the others around here look a little sleepy about this time of day.

"Now, it's possible," Potts continued, "that a relatively small amount of capital wisely used here and there could bring business enterprises to some parts of our area. A lot depends on whether we can make the best use of our human and natural resources, and whether you can find businesses that can compete."

While the Sam Houston Co-op now boasts 10,300 customers, it has probably shown a net loss in the number of customers over the past 12 months. Like other rural areas all over the country, it is losing population. That's worrisome to any utility manager whose career has been spent catering to an expanding number of customers.

Could an aggressive rural redevelopment program turn the tide—stabilize the rural population, or even sustain an increase?

Potts is not ready to give a strong affirmative answer on that one. But he'll try, and he thinks he has a fighting chance.

Letters

Cowans Ford: Peaking, Not Pump-Storage

To the Editor:

At the AIEE summer meeting, Mr J. Q. Wray of Duke Power Co described the Cowans Ford project. Allis-Chalmers Manufacturing Co is presently building three conventional vertical adjustable blade (i. e. Kaplan) turbine rated 121,000 hp at 92-ft head and 105.9 rpm. These are not pump turbine although pumped storage was considered for this project.

H. A. Mayo Jr
Turbine Sales
Allis-Chalmers Manufacturing Co
York, Pa.

▶ *Electrical World* acknowledges the error in its July 17 report of Wray's paper before the AIEE Summer General Meeting. We should have known better as we published an article on Cowan's Ford in our March 20 issue, page 62.

Crucial Decimal Point Misplaced

To the Editor:

On page 71 of your June 26 issue of *Electrical World* you printed a news release from our client, Davenport Mfg Div, Duncan Electric Co, describing the new high-voltage underground cable tester. We indicated a range of 0-45 kv dc and 0-30 kv dc. As it appears in your book, however, ranges are shown as "0.45 kv dc and 0.30 kv dc"—less by a factor of 100 than the correct ranges.

Unless the reader recognizes these ranges as typographical errors he will conclude that the editors of *Electrical World* and the engineers at Davenport have flipped their respective lids.

Frank R. Campbell Jr
Symonds, MacKenzie & Co
Chicago, Ill.

▶ Thank you for calling this to the attention of our readers.

This is your column in Electrical World. We invite your comments, questions, and criticism. Address Letters Editor, Electrical World, 330 W 42nd St, N. Y.

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You're inside one of over 130 local Graybar service centers – looking at what could be just part of your inventory, without a penny's investment. With such easy availability of electrical supplies, why should you pay the "cost of possession" that's the penalty of do-it-yourself warehousing? Let us stock most of your supplies until you need them. Let us work out with you a planned purchase program, so we know what you need and keep it on hand – even if your requirements are unusual. That way, we can give you same-day delivery of probably 95% of your requirements – and your inventory investment is cut to the bone. ■ Yes, think of Graybar's stocks as your own inventory, and call Graybar – for everything. Graybar Electric Co., Inc.: local service to utilities through coast-to-coast warehousing.

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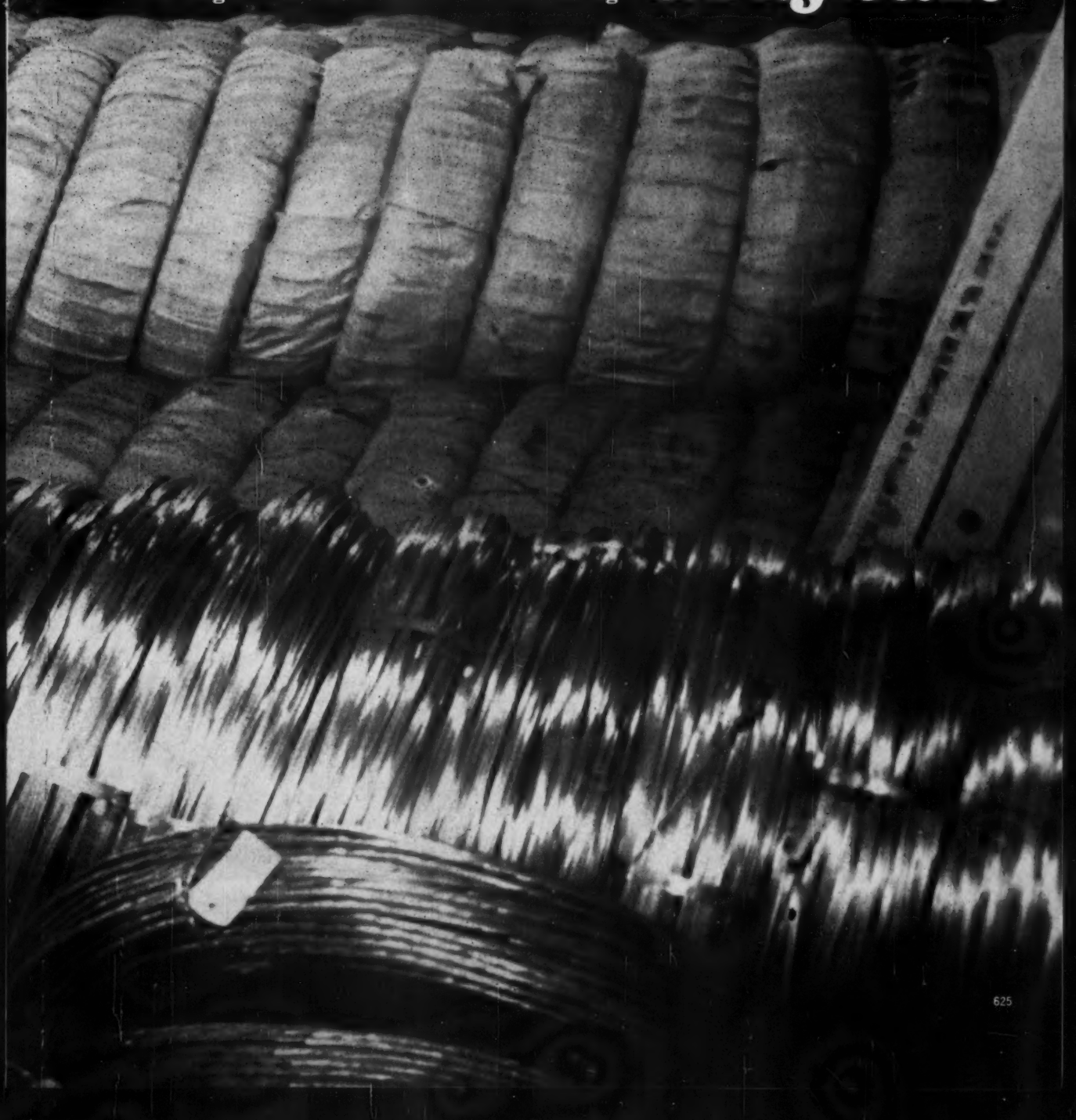


625

J-61015

Space-saving, design of SF_6 power circuit breaker places operating mechanism and cabinet below pole units in mounting frame, avoids interference with substation columns. Mechanically-linked pole units are closed pneumatically, opened by spring.

New:

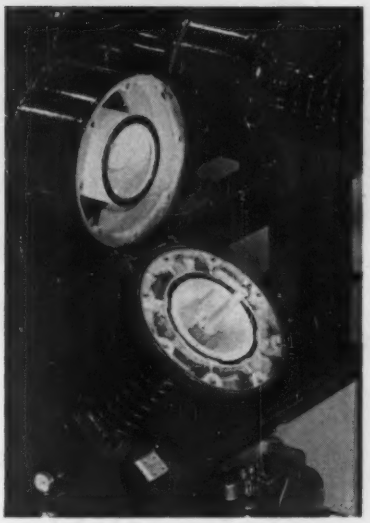
Compact 34.5 and 46kv SF_6 power circuit breakers are lighter, easier to maintain than conventional breakers

Now Westinghouse engineers have extended the revolutionary SF_6 power circuit breaker design to two new ratings—34.5 and 46 kv, 500 mva. This new breaker is a simple, low pressure device which does not require a gas compressor. Like the larger ratings introduced earlier, the new design combines the best features of oil and air blast breakers by taking full advantage of the unique properties of SF_6 gas: high dielectric recovery rate, exceptional dielectric strength and virtually unlimited life of SF_6 gas as an interrupting medium. Result is significant savings in space, foundation and maintenance requirements.

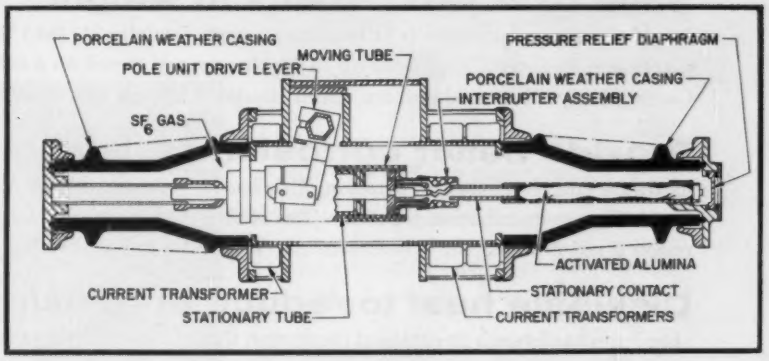
Simplicity of design made possible by the puffer-type interrupter is the key to greatly reduced maintenance. With only *one* set of contacts, *one* interrupter and *one* break per pole, adjustment is easy and there are few parts to wear out. In fact, indications are that these two new SF_6 power circuit breakers can be placed in service on a *five-year or longer maintenance basis.*

Your Westinghouse representative has complete technical details.

You can be sure . . . if it's Westinghouse



Hinged bushings provide easy access for inspection of contacts and current transformers. Two standard-accuracy current transformers may be mounted on one side of the interrupter and one transformer on the other side. This arrangement provides overlapping relaying protection if desired.



Heart of new, low-voltage design is puffer-type interrupter mechanism, shown here in cross section. Entire unit is filled with SF_6 gas at 45 psig. As breaker opens, cylinder moves to left. This action compresses the gas through an orifice to extinguish arc at tip extension of contact fingers.

Westinghouse

WHAT'S NEW*

about this Chance 10" EHV INSULATOR?

ALUMINUM CAPS AND STUDS

Save over two pounds in weight A Chance 10 inch insulator with forged aluminum hardware is at least two pounds (usually 2½ lbs.) lighter than any ordinary 10 inch suspension insulator. That adds up to 64-plus pounds saved on a 230 KV, 16 double-string deadend. Consequently Chance aluminum-fitted insulator strings are easier to handle, transport, and install.

Provide better corrosion resistance The forged aluminum alloy hardware effectively resists corrosion. This has been thoroughly proved in use on the highly successful 66160 Chance distribution insulator. The stud is *fully* supported in the body of the insulator . . . corrosion is not intercepted; it is eliminated. The cotter key is stainless steel.

Dissipate heat to reduce porcelain damage Because the aluminum hardware is an excellent conductor, these 10 inch insulators provide the advantage of fast heat dissipation during faults or surges. The porcelain insulator is not subjected to thermal shock damage.

ABC INDUSTRIES

A. B. CHANCE CO.
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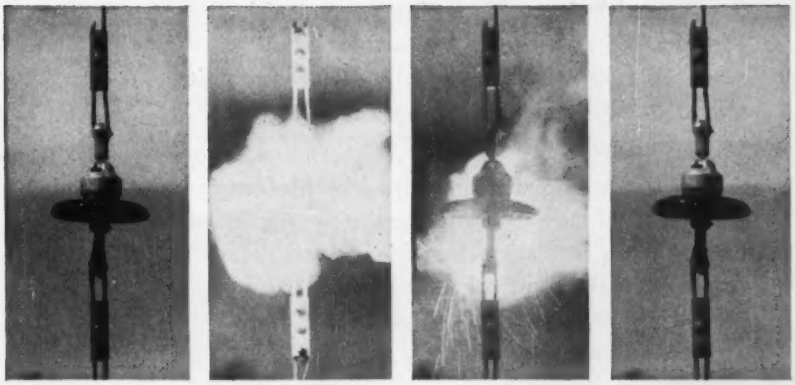
A. B. Chance Co. of Canada, Ltd., Toronto

C161-16

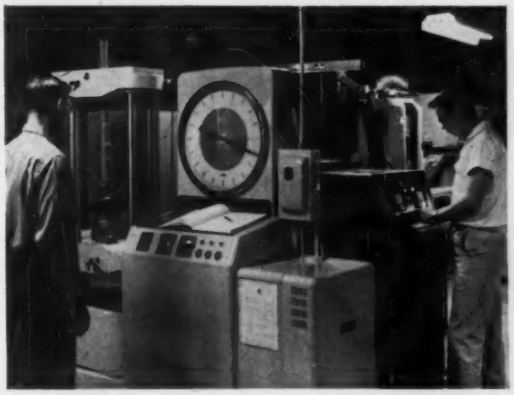


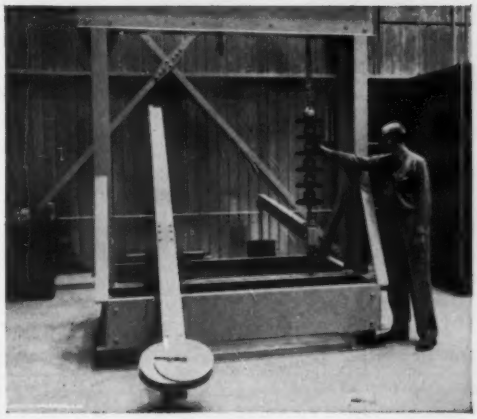
These frames show power arc tests on an insulator under a 4000 pound load subjected to 1700 amps for 10 cycles.

Mechanical and electrical tests after the power arc test prove the insulator free from thermal shock damage. Aluminum dissipates heat faster than ferrous metals to protect the porcelain.

MANY TESTS PROVE THAT CHANCE 10 INCH EHV INSULATORS CAN SERVE YOU BETTER

These new aluminum fitted insulators are completely tested to prove their ability to give many years of unfailing service on your lines. Tests include 60 cycle wet and dry flashover tests; positive and negative impulse flashover tests (1½ x 40); steep wave front tests (8000 KV per microsecond rise); high fault current tests; vibration tests; special extended-time load tests; oil puncture, radio noise influence, thermal shock and all standard mechanical and electrical tests. A few of these tests are shown here. For more information, contact your Chance ServiCenter or insulator representative.





This time load test proves the mechanical strength of the insulators. During the time load tests, the insulators are subjected to daily steep wave front flashover tests to check electrical soundness while on load.

Both aluminum and ferrous metal fitted insulators are subjected to a 500 hour salt fog test. The aluminum insulators show little corrosive effect, while the ferrous caps are badly corroded.

A patented,* electronic testing system subjects Moloney Distribution Transformers to all standard tests and automatically rejects any unit which does not meet Moloney's standards of performance.

Automatic testing was developed by Moloney Electric Company to eliminate the possibility of human error in transformer testing and to improve quality control. Users can be sure that Moloney Transformers have successfully passed all tests and are electronically approved for service.

This patented,* automatic test system is one of many Moloney developments leading the way to better products for transformation. Specify electronically proven Moloney Distribution Transformers.

ME61-6

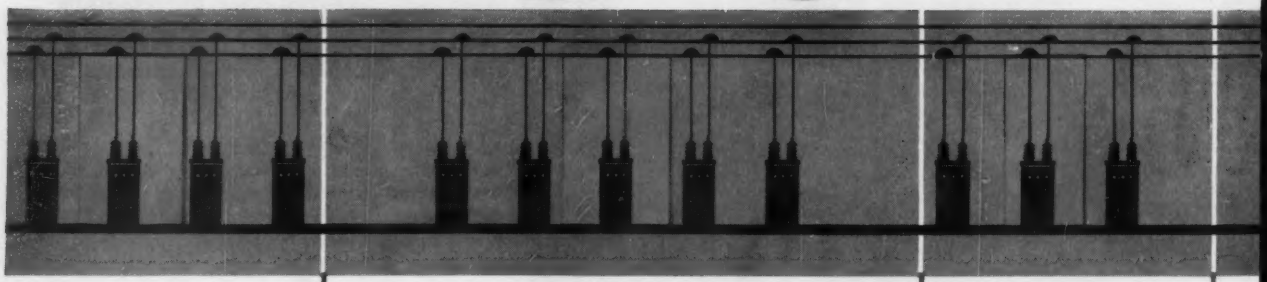
PATENTED* SYSTEM ELECTRONICALLY TESTS MOLONEY

MOLONEY ELECTRIC COMPANY

Since 1896... MORE POWER TO YOU

ST. LOUIS 20, MO., AND TORONTO, ONT., CANADA

*U. S. PATENT NO. 2905891



RATIO TEST

Supplements complete ratio test given each core-and-coil unit before tanking, checks each transformer for correct voltage ratio and ratio adjuster position.

IMPULSE TEST

Proves each transformer capable of withstanding over-voltages resulting from lightning and switching surges by overstressing bushings, layer, turn and divisional insulation as well as insulation between high and low voltage windings, and between the windings and ground.

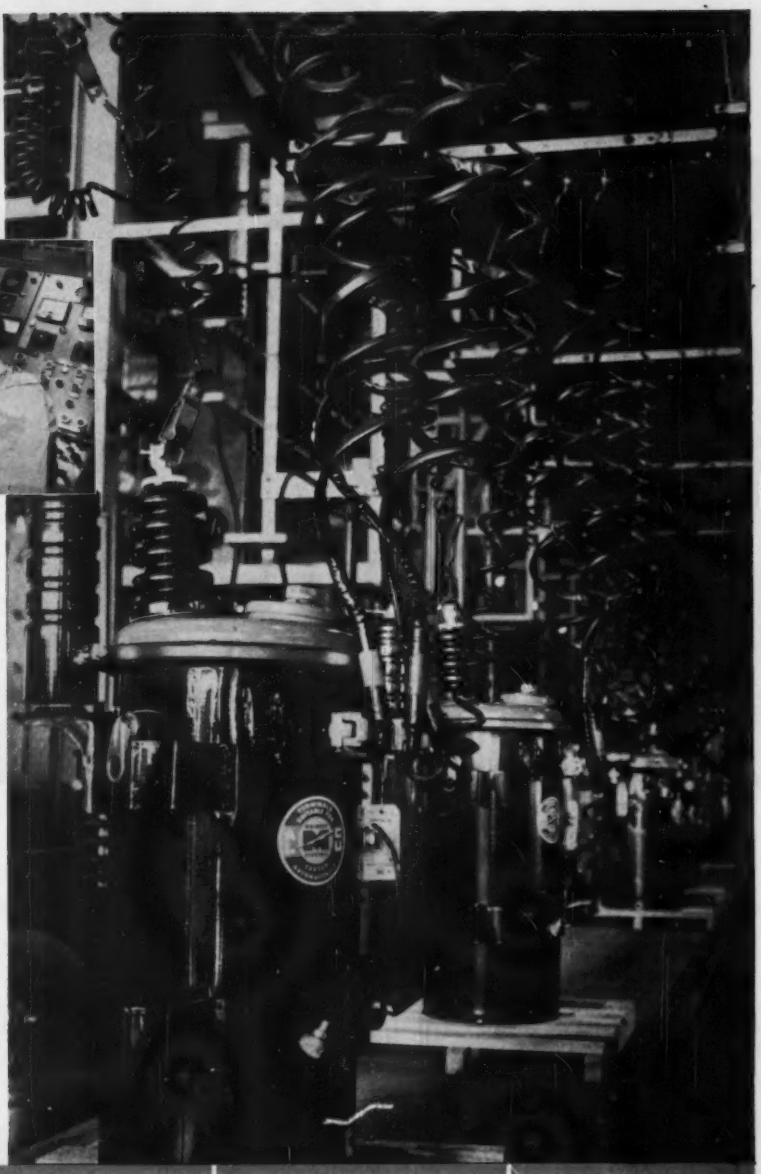
INDUCED POTENTIAL TEST

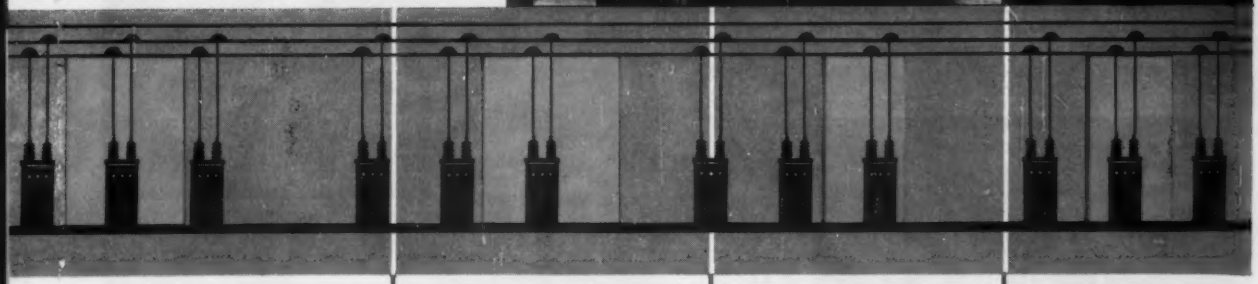
Proves turn, layer and divisional insulation quality of high and low voltage windings.

TEST SYSTEM—After completion of all assembly operations, a moving belt conveyor transports transformers through the automatic test system. Leads connecting the transformers to overhead dollies are attached before the transformers enter the test area. Power for each test is supplied...automatically ...by overhead bus at each test station.

CONTROL ROOM—Central control room houses all test station controls, test metering and recording equipment, and electronic rejection circuits.

TRANSFORMERS





APPLIED POTENTIAL TEST

A low-frequency, high-voltage test of insulation quality between high and low voltage windings, and between windings and ground.

CORE LOSS AND EXCITING CURRENT TEST

Equipment automatically measures the core loss and exciting current of each transformer.

SOUND TEST

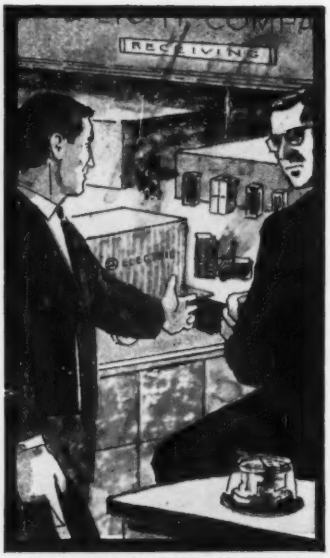
The audible sound level of every transformer is measured while the unit has normal excitation voltage applied.

CSP BREAKER TEST

When applicable signal light and breaker operation is checked under overload conditions for proper operation.

JET STREAM SERVICE is a unique, automatic warehousing system that assures you of immediate delivery on standard high-volume meters, sockets, instrument transformers. ▼

◀ **STATISTICAL SAMPLE TESTING SEMINARS** provide utilities with an idea-center for discussion of statistical techniques.



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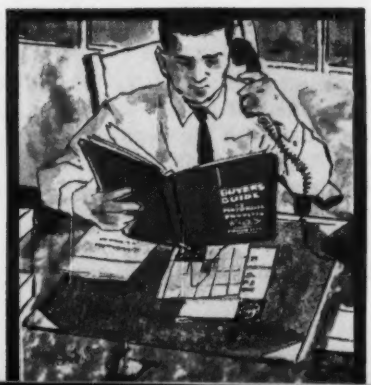
▲ **CERTIFIED QUALITY** program assures meter accuracy and reliability—average accuracy within 0.1% of reference kilowatt hour, 99.9% free of defects.

▲ **APPLICATION ASSISTANCE** helps in the correct selection of equipment, solving of metering problems.

▲ **PRODUCT SERVICE** aims at full customer satisfaction in any problem area; supplies technical data and assistance.

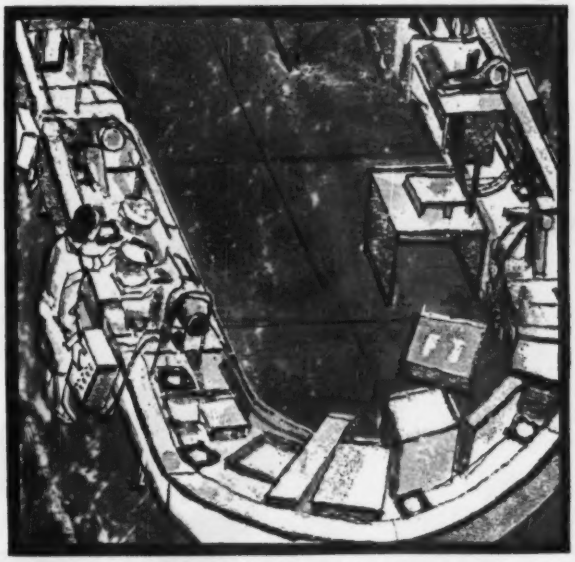
◀ **METER COURSES** teach basic information—and new advances—on single- and polyphase meters, help utilities cut training costs.

INDUSTRY COMMUNICATION—G. E. disseminates metering information of all kinds—technical, informative, statistical—to keep utilities abreast of new developments. ▶



You get all 10 metering extras from General Electric

LOAD BUILDING helps utilities in long-range expansion efforts—has long been supported by G. E. through programs such as Live Better Electrically, Medallion Homes, Residential Market Development.



LOW COST PER KVA results from advanced automated techniques, leadership in meter research and design.

The complete value of a metering purchase is not measured in product alone. The service a manufacturer supplies to meet utility needs, help solve utility problems, also represents substantial bonus value.

You see on the left a select group of the metering services General Electric provides the electric utility industry—10 valuable extras that cover the complete range of metering needs. Many of these extras go beyond the usual customer service; many have led the way for what is now accepted industry practice; many are exclusive with General Electric. Evaluate these metering extras in light of your own use. Measure the cost if you were to supply these services yourself. This is their worth to you.

Considering over-all value, what do these metering extras mean to you? Just this. When you buy General Electric, you get the best possible metering buy. General Electric's unmatched service package, teamed with industry's most advanced metering products, including such vital accessories as butyl-molded instrument transformers and meter sockets, means your metering dollar goes further, buys more, provides you with greater value than available elsewhere. For example, consider the product innovations pioneered by General Electric in single-phase meters.

- Magnetic-suspension bearing system—Between 1948 and 1960, more than 13,000,000 G-E magnetic-suspension meters were produced and in service on utility lines before other meter manufacturers adopted a form of magnetic bearing system.
- Steadily increased capacity—The capacity of G-E standard 3-wire, socket-type single-phase meters has more than tripled in recent years; yet, the cost per KVA of meter capacity has dropped from $0.98 to $0.32 just since 1954.

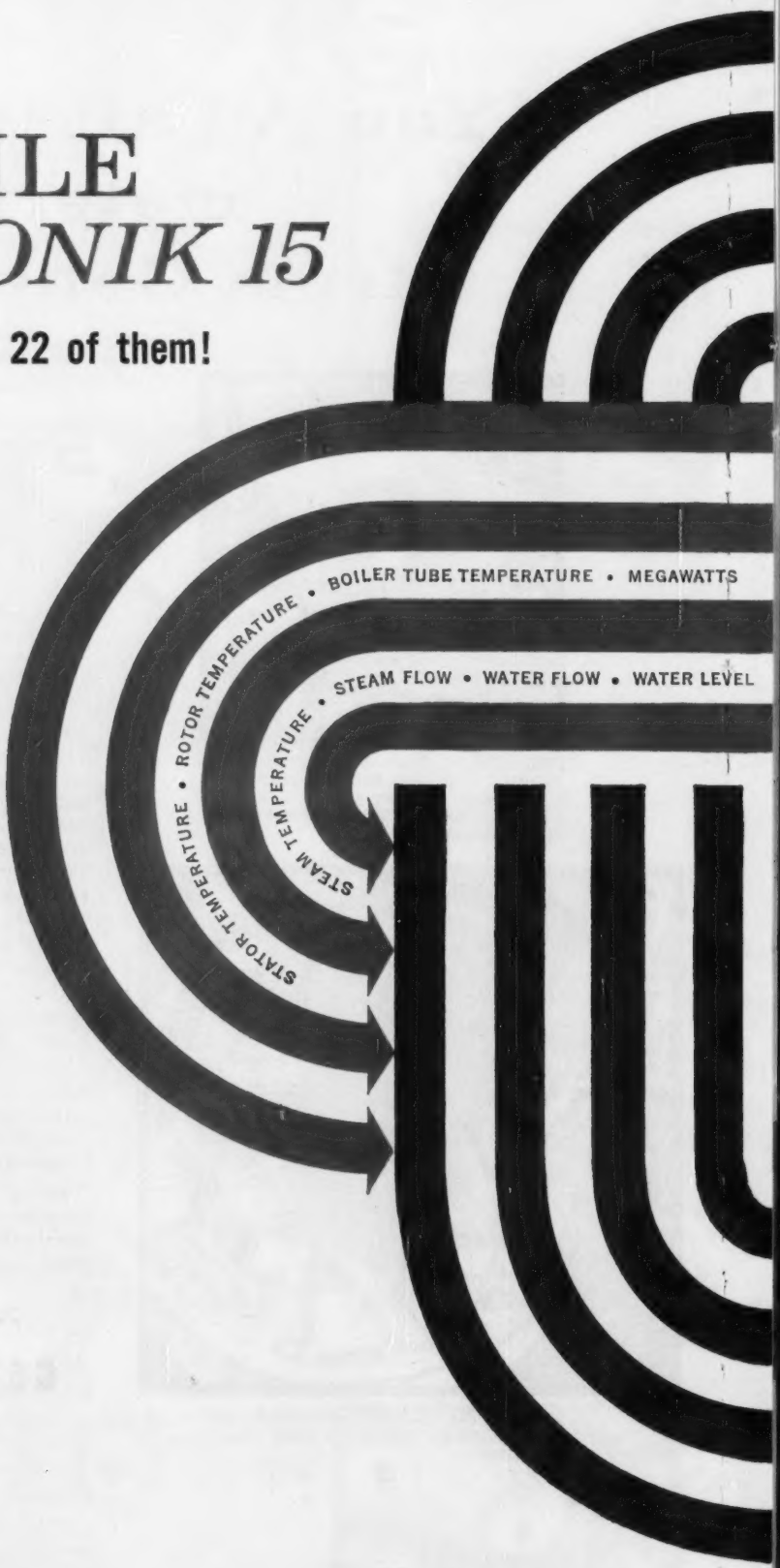
Before you place your next metering equipment order, measure the whole package — product and service. Then specify General Electric for today's most complete metering value . . . your best buy. 713-08

Progress Is Our Most Important Product

GENERAL ELECTRIC

VERSATILE *ELECTRONIK 15*

records and indicates all 22 of them!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STEAM TEMPERATURE • STEAM FLOW • WATER FLOW • WATER LEVEL

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CONDUCTIVITY • pH
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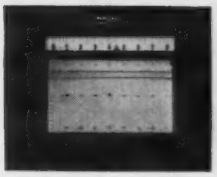


Generating Stations and Dispatch Centers depend on Honeywell *ElectroniK 15* instruments to keep a close check on more than 22 variables . . . from watts, vars, steam flow, stator temperatures . . . to system frequency, tie line interchange, and time deviation.

ElectroniK 15 gives a choice of many measuring circuits, types of records or indication, pen or print wheel speeds . . . lets you incorporate a wide variety of functions or devices. The newly designed modules in the *ElectroniK 15* line have operating and servicing features that represent the very latest developments in the art of reliable instrumentation. Its 11-inch calibrated chart width provides easier, more accurate reading. 112 Honeywell service and sales offices throughout the country are dedicated to the job of keeping *ElectroniK 15* instruments in top operating condition.

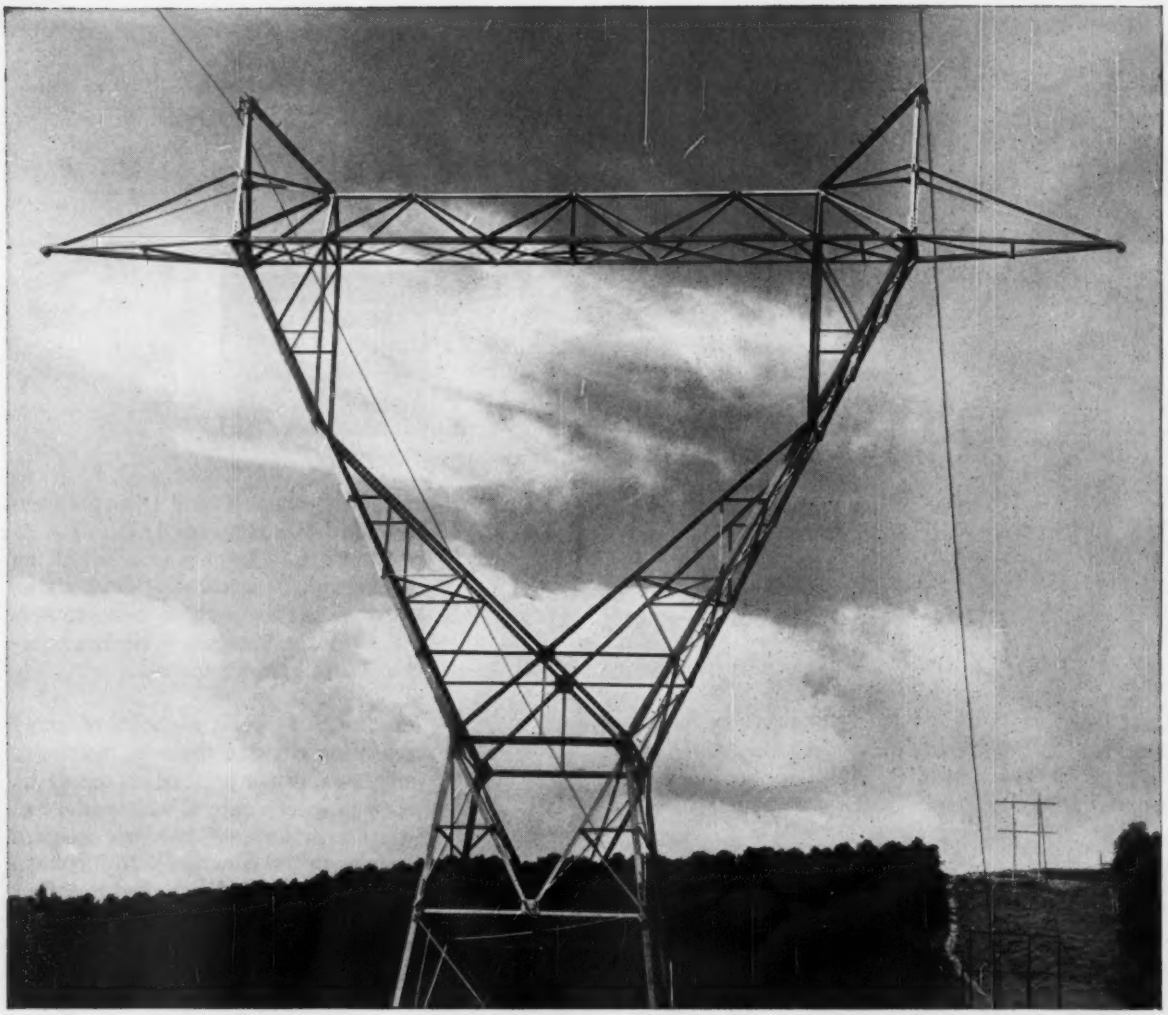
With *ElectroniK 15* on the scene, it is no longer necessary to be strapped to a single line of instruments. Many leading utilities throughout the country already know about *ElectroniK 15's* performance and dependability. You can get the facts on the *ElectroniK 15*, too, by contacting your nearby Honeywell field engineer. MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

Honeywell

First in Control

SINCE 1885

HONEYWELL INTERNATIONAL Sales and Service offices in principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.



Nation's first 460-KV system is protected by Bethlehem overhead ground wire

The nation's first operating 460-KV power transmission line was recently energized by Pennsylvania Electric Company in mountainous terrain between Claysburg and Saxton, Pa. Since operating conditions are abnormally severe, an extensive testing program will be carried out, including studies of lightning strokes.

Protection against lightning is of major importance in extra high-voltage lines. For this reason, PENELEC chose Bethlehem's bethanized "C" coated, ½-in. diameter, extra high-strength strand for 6½ miles of the 13-mile line. Bethanized strand, with its smooth coating of pure, electrolytic zinc is ideal for static application. It acts as a shield to the conductors by intercepting lightning strokes and grounding them.

Today's long spans make overhead ground wires susceptible to fatigue caused by vibration. Steel, because of its high endurance limit, is best able to withstand these fatigue stresses. Bethanized wire has comparable endurance limits to uncoated steel wires, and fatigue tests indicate its superiority over other types of coated wire for this type of service.

For full information on the wide range of sizes and strengths of bethanized strand, get in touch with the nearest Bethlehem sales office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation
Distributor: Joslyn Mfg. & Supply Co.

Steel *for Strength ... Economy ... Versatility*

BETHLEHEM STEEL

BETHLEHEM STEEL

Pennsylvania power transformers "on the line" in Wisconsin Electric Power Company's new Oak Creek Unit No. 5. *Lefthand cell:* 315,000-kva main step-up transformer. *Middle cell:* two 10,000-kva main auxiliary transformers. *Righthand cell:* 12,000/16,000/20,000-kva starting transformer.

Stepping-up for Wisconsin's highest voltage...

Largest Pennsylvania transformer to date serves new 230-kv transmission line

Although well known for its brewery products, the heavily populated Milwaukee area is actually the scene of a wide variety of commercial, industrial and agricultural activities. North of Milwaukee there is less diversity but a high degree of mechanization in the large farms and paper mills . . . while across the border, in upper Michigan, the principal industries are mining, lumber, and recreation.

To keep pace with, and anticipate, the power needs of these diversified industries, Wisconsin Electric Power Company recently added a 275,000-kw unit to its Oak Creek Plant. A 315,000-kva Pennsylvania Contour Design Transformer steps up the generated voltage of 17.2 kv to 230 kv, a new high in transmission voltage for Wisconsin.

New Tank Cuts Weight and Size

Although the largest transformer—from the standpoint of capacity—that Pennsylvania has built to date, Oak Creek No. 5's main step-up transformer was shipped to its destination in an upright position and completely assembled except for external accessories and oil. Pennsylvania's new three-piece, shell-form tank is the secret of such compact, lightweight construction. The result is important savings in time and installation costs.

The two main auxiliary transformers as well as the starting auxiliary transformer for Oak Creek's new Unit No. 5 also are Pennsylvania's. Unit No. 6—now under construction—will be equipped with similar Pennsylvania transformers.

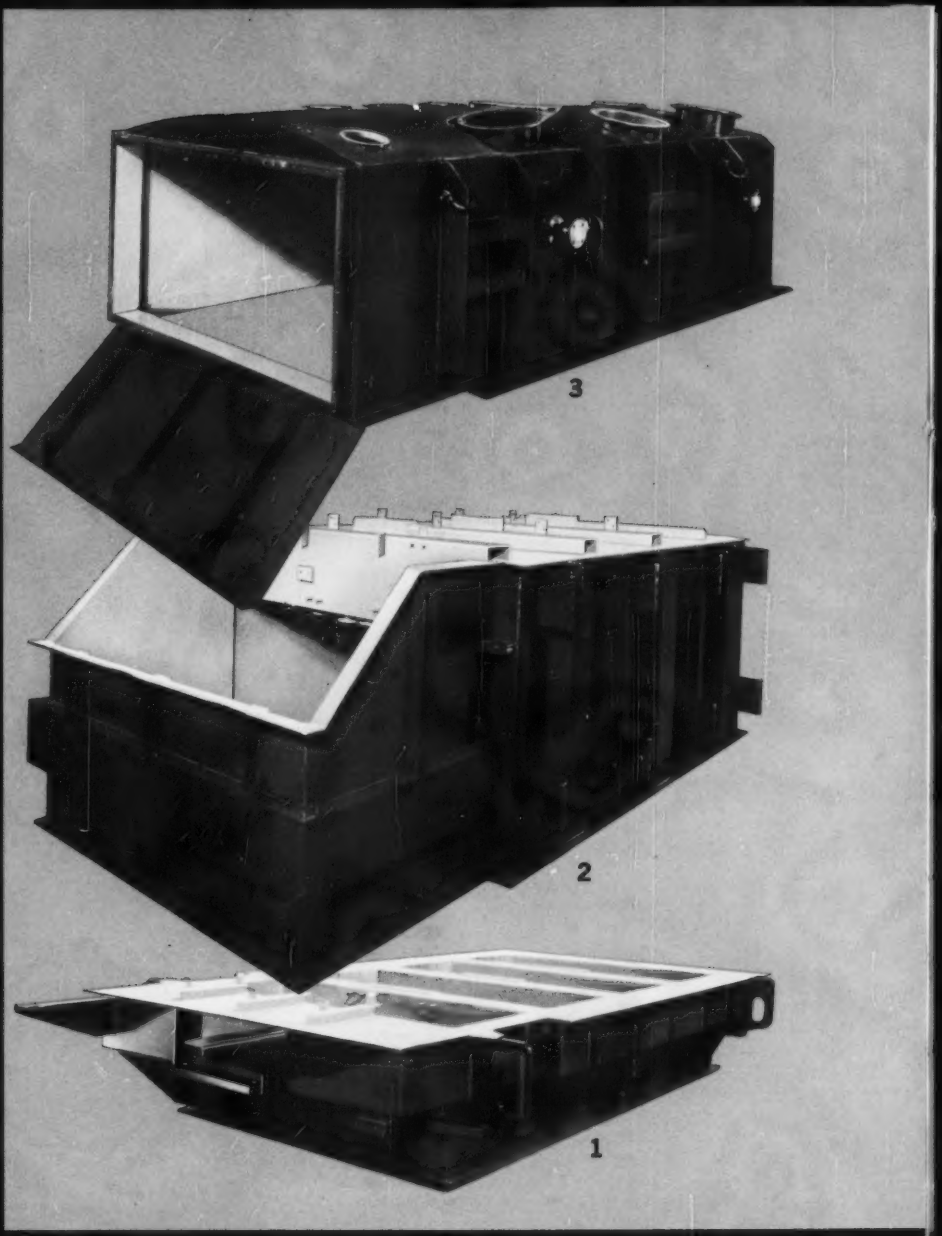
Catalog No. P-560 tells the complete design-and-construction story of Pennsylvania Contour Design Shell-form Transformers. For a copy, write on your company letterhead to Power Transformer Sales, Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pa.

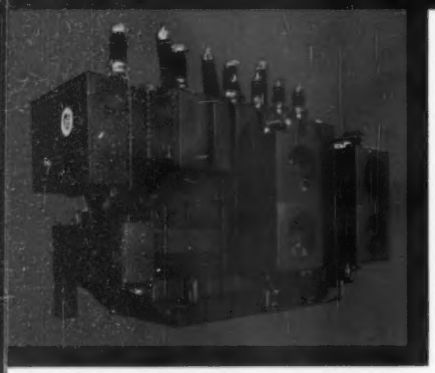
PENNSYLVANIA POWER TRANSFORMERS

See other side for design details

Structurally STRONGER... yet SMALLER and QUIETER

New 3-section Contour Design tank packs more power into Pennsylvania shell-form transformers





The example shown is an 80,000-kva three-phase class FOA Pennsylvania Contour Design Transformer. 133,700△ volts. LV: 35,600 GryY/20,560 volts.

Used now for all Contour Design Shell-form Transformers, Pennsylvania's new three-section tank eliminates the need for a separate frame for core and coils. Instead, the core and coils are assembled in the tank base section (1) . . . and when the center section (2) is added and welded into place, it provides sturdy side bracing for the internal assembly. Before the top section (3) is added, the core is clamped to the bottom section by means of closely spaced jack screws. Careful control of the jack screw pressure reduces the sound level of the entire structure . . . assuring even *quieter operation than ever before.*

The reduced weight and size resulting from the new three-section tank design permit even transformers as large as the 315,000-kva unit shown on the other side to be shipped upright and completely assembled except for external accessories and oil. Also, transformers are structurally stronger—in effect underlining the internal ruggedness for which Pennsylvania Contour Design Transformers have long been noted.

PENNSYLVANIA TRANSFORMER DIVISION • McGRAW-EDISON COMPANY • CANONSBURG, PA. • Greater Pittsburgh District

See other side for installation story

Electrical World

AUGUST 14, 1961
Vol. 156, No. 7

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FLYING HIGH: Utility's aerial basket fleet will be doubled.

FUTURE NEWS ▸ **Protest will probably be made** by one of the bidders involved in bidding for thirteen 212,400-hp hydraulic turbines for John Jay and Lower Monumental Dams in Washington (EW, Aug. 7, p 14). If controversy arises over bids, it could be similar to 1959 hassle over Glen Canyon Dam turbines.

LATE NEWS ▸ **British Columbia Premier W. A. C. Bennett, fresh from his takeover** of B.C. Electric Co (see page 64), says in San Francisco news conference that he is really a champion of US-Canada Columbia River development treaty but wants to make sure of certain things before B.C. allows construction to begin. Meanwhile, his aides drop in on Pacific Gas & Electric Co President Norman R. Sutherland to look into the sale of Columbia power to California.

Senate confirms nomination of Lawrence J. O'Connor Jr to FPC by a vote of 83-12 Aug. 9 after 33-hour talkathon by Sen William Proxmire (see page 68).

Commonwealth Edison Co and Illinois Bell Telephone Co are authorized by Illinois Commerce Commission to make first field trials in this country of power and telephone cables placed with random separation at the same level in a common trench for residential underground systems. Authorization states that "elimination of (existing) requirements for 12 in. of separation can reduce cost of digging and backfilling by about 25% . . . and should stimulate use of buried construction."

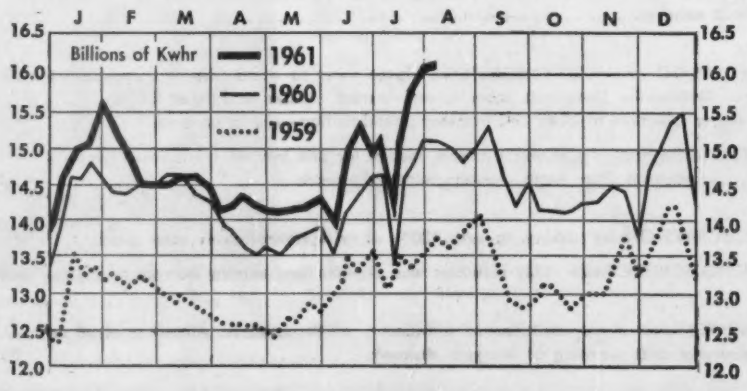
Recently announced new TVA schedule is ridiculed in the Senate by Barry Goldwater (R-Ariz.) as "deceptive." He adds, "So far as I can see, TVA has made no rate reductions at all. . . . I wonder if the TVA of today, of which Sen Norris is called the father, is what the Senator visualized?"

Standard line of boiling water atomic power plants are offered by General Electric Co. Plants will carry nominal ratings of 100, 200, 300, 400, and 500 Mw and will be offered at firm prices and with guaranteed net plant electrical output.

Public Service Co of Colorado and Colorado Central Power Co announce agreement on general merger terms. Details are being worked out and will be submitted to directors of both companies.

FPC overrules one of its examiners and says that Southern California Edison Co is subject to FPC jurisdiction for its sales to the city of Colton, Calif. FPC notes that some of SoCalEd's power comes from Bureau of Reclamation's Hoover-Parker-Davis Dams, and this makes regulation an interstate matter.

WEEKLY POWER OUTPUT—Up 6.7% (Week ending Aug. 5), Kwhr 16,137,000,000



Per Cent Change From Previous Year

	July 22	July 29	Aug. 5
Total U. S.	+ 6.7	+ 6.3	+ 6.7
New Eng.	+ 7.8	+ 9.8	+ 5.4
Mid. Atlan. ...	+11.7	+14.0	+ 6.2
Cent. Ind.	+ 5.4	+ 2.4	+ 6.6
West Cent.	+ 5.0	+ 4.9	+13.0
Southeast	+ 3.8	+ 7.9	+ 6.7
South Cent. ..	+ 9.0	− 1.1	+ 2.9
Rocky Mount...	+10.6	+ 7.5	+ 5.2
Pacific			
NW	+ 5.5	+ 7.6	+ 5.9
SW	+ 6.3	+ 6.7	+ 9.6

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Source: Edison Electric Institute

Supply Lines

PHILADELPHIA ELECTRIC FILES 'CLASS ACTION' DAMAGE SUITS

Philadelphia Electric Co has filed 11 triple-damage suits against 24 electrical manufacturers as a result of the antitrust cases. The company filed the suits also on behalf of about 25 investor-owned utilities furnishing electric service to consumers in Pennsylvania. These "class actions" allow any of the 25 utilities to intervene in any or all of the suits if they want to. Products involved are turbine-generators, power capacitors, meters, power transformers, circuit breakers, power switchgear assemblies, industrial control equipment, distribution transformers, power switching equipment, instrument transformers, and condensers. Damages are not specified, but PE says $68-million worth of equipment is involved for PE alone.

At the same time, Conowingo Power Co, a PE subsidiary, filed two suits against seven manufacturers. Distribution transformers and meters, totalling about $180,000, are involved. This is the second set of damage suits filed by investor-owned utilities as a result of the antitrust cases (EW, Aug. 7, p 13).

CORDINER STILL THE BOSS AT GENERAL ELECTRIC

General Electric Co's top corporate team has some new members but the captain is still the same: Ralph J. Cordiner, chairman and chief executive officer. As a result, the recent naming of Gerald L. Phillippe as president and Cramer W. LaPierre as executive vice president does not mean any radical shift in company policy. Nor does it mean that Cordiner is preparing to relinquish his post in the near future. At a press conference held after the new team members had been appointed, Cordiner implied that were it not for the troubling times that GE finds itself in, he now might have been entertaining thoughts of retiring and "counting cattle" on his Florida ranch.

But the picture has changed, and, in Cordiner's words, "I no longer have a free choice to determine when to retire." At the same time, he noted that he has a mandate from the company's board of directors to continue in his present post. As an aftermath of the company's Philadelphia antitrust problems, there was much speculation in the press that Cordiner would be forced out. But Cordiner's hold on his job now appears to be tighter than ever, with the crucial turning point probably having been his successful handling of the annual shareholders meeting last April.

Why does Cordiner feel compelled to stay on the job? Probably because he wants to have the company in the shape he thinks it should be after having been at the helm over ten years. Put another way, Cordiner has a certain amount of pride and wants to turn the company over to his successor only when it is reasonably free of major problems.

One problem, which Cordiner denies was a major one influencing his decision to stay on the job, is the many-faceted antitrust situation. First, there is the irksome question of damage suits to settle (which will probably take more time to complete than the 3½ years he has until he reaches the mandatory retirement age of 65). More importantly, there is the company's present fight with the government over the wording of the antitrust consent decrees. Threatened by the government with divestiture proceedings, the company, in Cordiner's words, is taking a "calculated risk" by remaining adamant in its position. Finally and still in the antitrust realm, there is the matter of trying to make sure that company personnel

don't stray from the proper path in the future. On this score Phillippe has been and is still playing an important part.

To Cordiner, the company's major problems are (1) keeping pace with the technological breakthroughs; (2) the cost-price squeeze on profits; and (3) "aggressive and continuing" foreign competition. To meet these problems, Cordiner has split his previous duties three ways.

To Phillippe, who was formerly comptroller, he has handed the job of running the services (also known as staff or headquarters) functions of the company. These include accounting, engineering, law, management consultation, manufacturing, marketing, relations, research, and treasury. Because of his talents for efficient administration and cost control, Phillippe will thus make a contribution towards increasing the profitability of the company.

To LaPierre, formerly electronic and flight systems group vice president, goes the job of long-range planning and the problem of the company's keeping pace with technological breakthroughs. This is an entirely new position within the company.

Finally, Cordiner will retain the duties of running the operations (as against services) end of the company, and as such will have the five group vice presidents reporting directly to him. Thus Cordiner will be immediately concerned with the cost-price and off-shore competition problems, but, as chief executive officer with Phillippe and LaPierre reporting to him, he will have a hand in their affairs also.

With the operating groups reporting to the chief executive officer, the company will be returning to a pre-1957 corporate structure. When Robert Paxton became executive vice president in 1957, the operating groups went under his direction although Paxton was not chief executive officer. Apparently, this experiment did not work out. Cordiner's explanation is that it was found that operating personnel were too used to reporting to the chief executive officer to change their habits.

With this new corporate team, the company can probably be expected to be a more formidable competitor in the marketplace. At the same time, GE will continue its emphasis on international operations ($1 billion in overseas sales is the 1964 goal as against $600 million last year), and its stress on new technologies such as atomic energy, electronics and space.

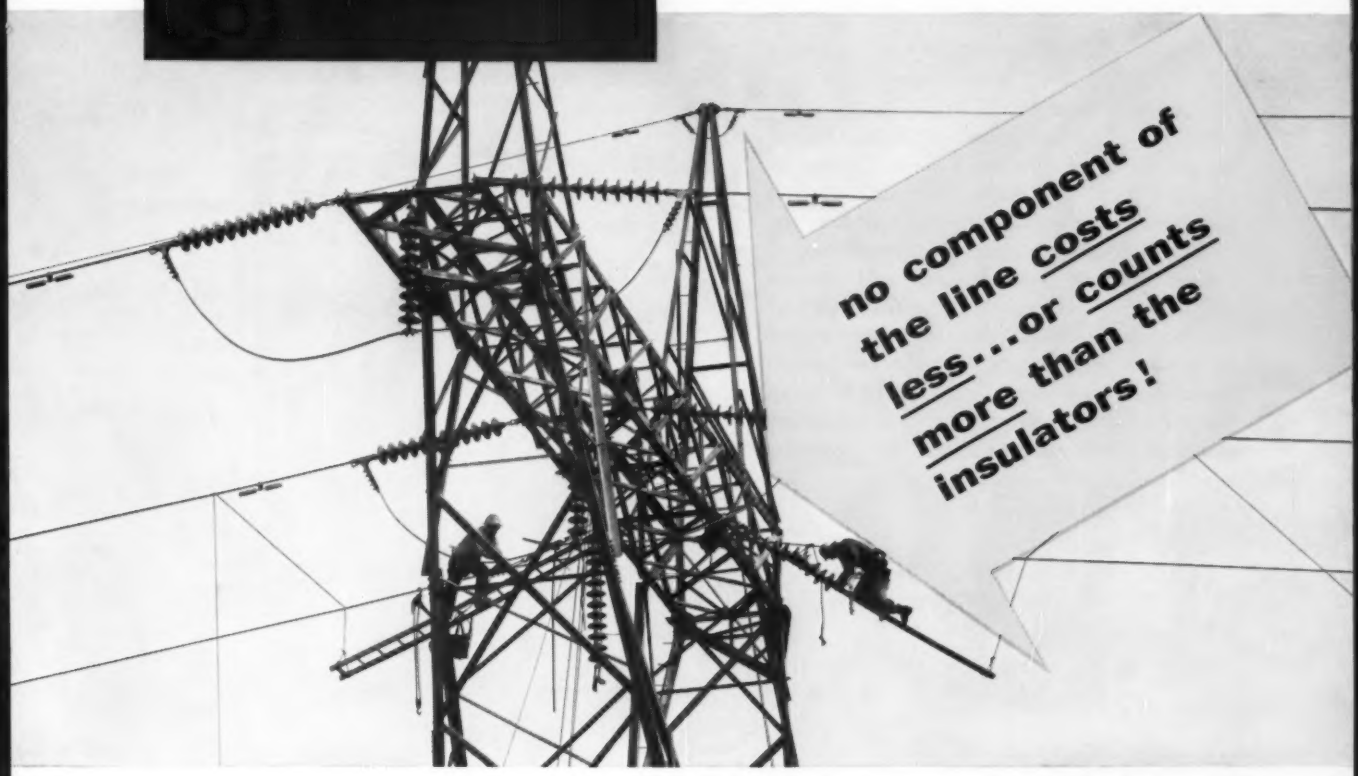
METER PRICES TO BE RAISED; MOTOR PRICES REDUCED

Prices of watthour meters, mechanical demands, Lincolns and utility time switches will be raised Oct. 1 by Sangamo Electric Co when it changes the utility discount from 40% to 39%. At the same time, the company will increase to $10 the list price differential between socket-type and bottom connected-type watthour meters.

In another field, Westinghouse Electric Corp reduced prices Aug. 3 on one to 125-hp motors an average of 7½% while instituting a new motor pricing policy which provides that any future price increases which become effective after the date of the order would not apply to items shipped within 30 days of the order. After 30 days and before six months from order date, the increase will not exceed 5%, and between six and 12 months, the increase will not exceed 10%.

line cost– $85,000 per mile

insulators– $2,500 per mile



This tower has a busy future ahead. It's insulated now for a single 138-kv circuit. Later, it may carry a second 138-kv circuit. And eventually, it will support a bundled-conductor 345-kv line.

At the ultimate voltage, as shown in the figures above, cost of the O-B suspension insulators will total less than 3% of the cost of the line, including right of way.

No component costs less - - yet none is more important to the overall performance of this line.

For the purchaser of suspension insulators, this fact has a double-edged significance.

First, it means that the *overall cost* of a transmission line *cannot be materially reduced* by cut-rate prices on a component that accounts for only 3% of the overall cost.

Second - - and more important - - it means that *overall performance* of the line *can be materially reduced* by the cut-rate quality that usually accompanies cut-rate price.

Nowhere, in other words, do "penny savings" entail greater "dollar risks."

Your O-B representative has convincing proof of this in the form of a 25-minute sound-color film entitled, "The Second 50 Million."

Why not ask him to arrange a showing in your office?

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10085-H

COMPLETE RILEY BOILER

for GOLDSBORO STEAM ELECTRIC STATION CAROLINA POWER & LIGHT COMPANY

The high pressure natural circulation Riley reheat steam generating unit soon to be installed at the Goldsboro Steam Electric Station of Carolina Power & Light Company features radiant superheater platens which will have the effect of reducing furnace gas temperature to correct levels at exit and also will produce uniform temperature across the full width of the furnace. Reheater temperature is controlled by dampers without spray under normal conditions. Steam temperature is controlled by spray. Large downcomers spaced equally across length of drum provide uniform feed to generating tubes.

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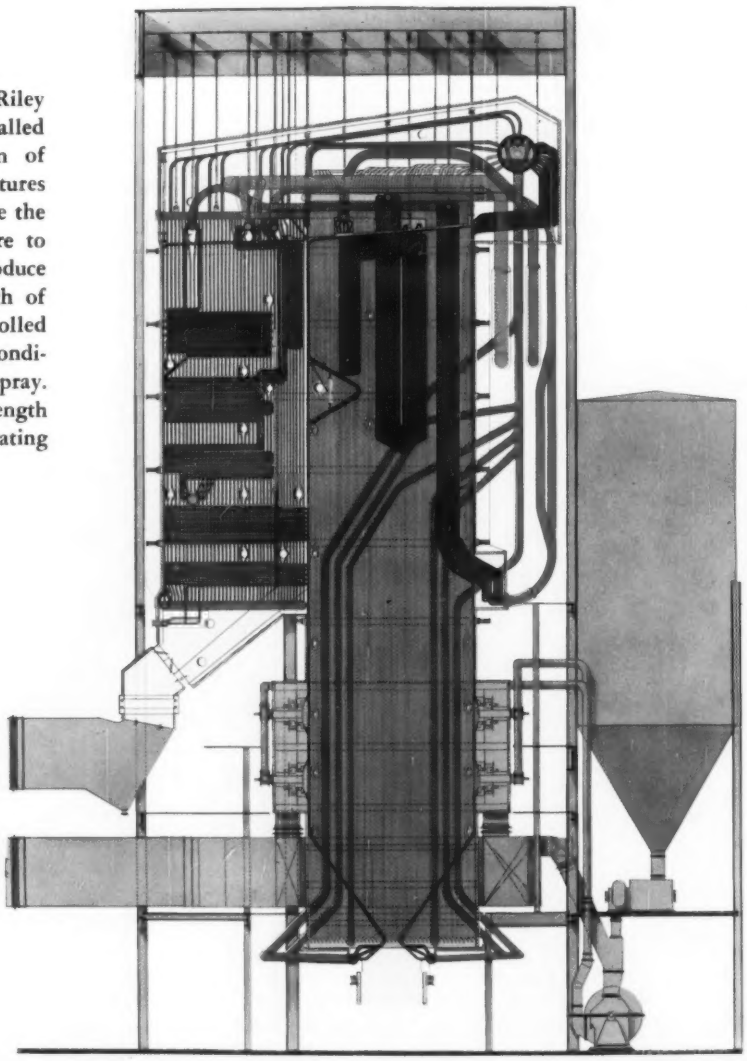

RILEY COAL FIRED BOILER for

GOLDSBORO STEAM ELECTRIC PLANT
Unit No. 3
CAROLINA POWER & LIGHT COMPANY

- Capacity ..... 1,620,000 lbs/hr
- Operating Drum Pressure ..... 2640 psig
- Superheat/Reheat ..... 1005/1005 F.
- Fired by Coal
- 5-550 Riley Pulverizers
- 20 — Riley Burners Arranged for Opposed Firing in Single Furnace — 58 feet wide.

A careful survey of your plant by a qualified consulting engineer could show ways of making substantial savings in power costs.

RILEY

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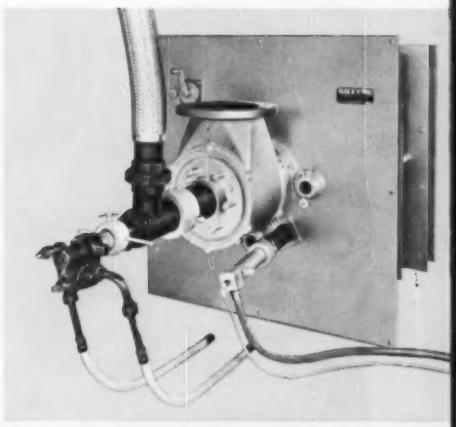
features

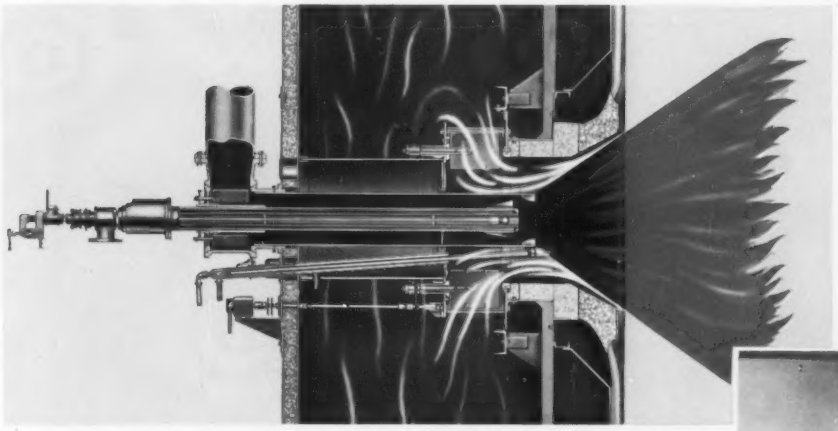
- 2640 P.S.I. OPERATING PRESSURE
- PLATEN TYPE RADIANT SUPERHEATER
- NEW TYPE 60 FLARE TYPE BURNER
- OPPOSED WALL FIRING
- NEW TYPE 60 DUPLEX PULVERIZERS

NEW RILEY BURNER HAS SIMPLIFIED FRONT PLATE — IDEAL FOR AUTOMATIC OPERATION

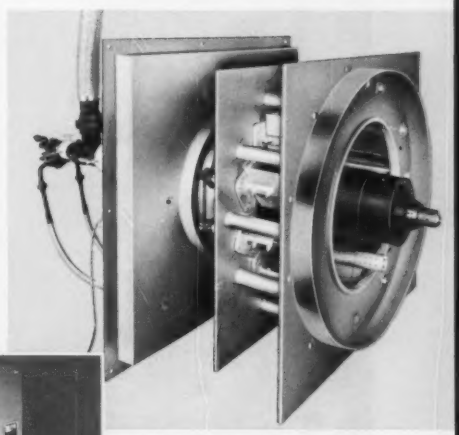
Some Operating Advantages:

- Mechanical moving parts move with boiler expansion—will not bind or jam.
- Vane control mechanism does not require lubrication.
- Automation with remote secondary air vane adjustment and indicators.
- Idle burners and ignitors well protected.
- Smooth, stable non pulsating flame thru load range.
- Non-plugging coal nozzle design.
- Turbulent mixing of primary air-coal secondary air.
- 180° rotation of vanes.

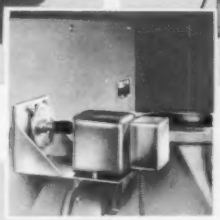




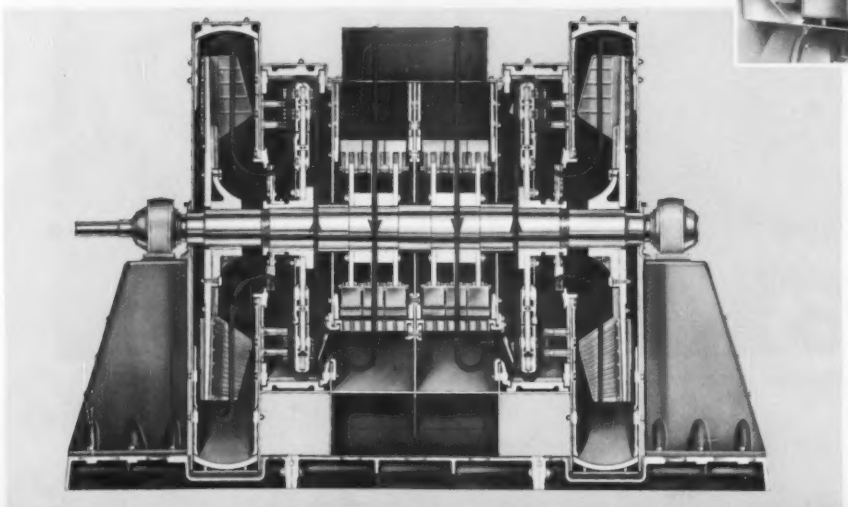
Arrangement for coal, oil, gas with pressurized boiler operation.



Above — Burner assembly for water-cooled burner throat.



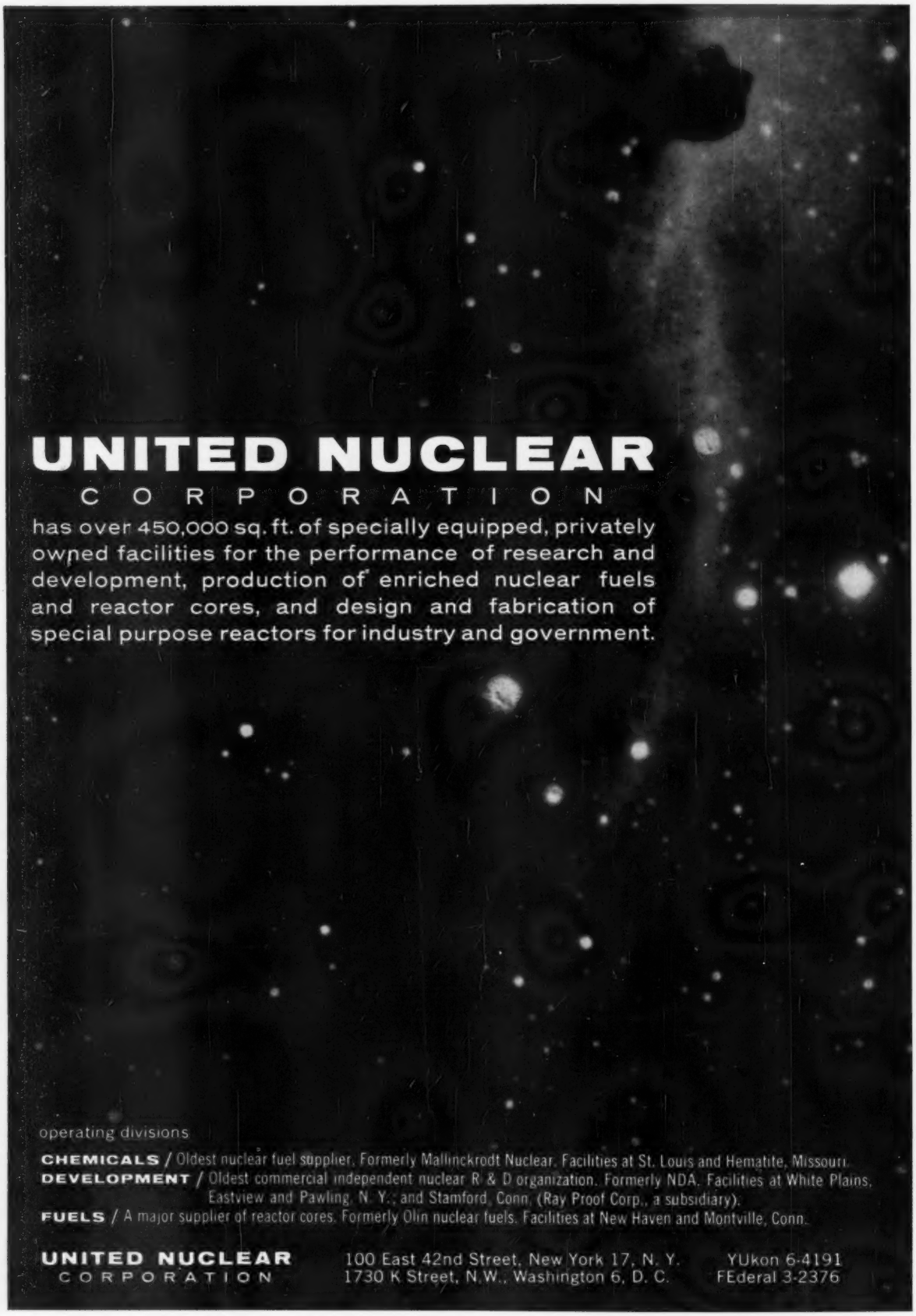
Power unit for automated operation



NEW TYPE 60 DUPLEX PULVERIZER — has single coal entrance—two exits. New arrangement reduces number of feeders required. Simplifies automatic control of supply of coal and primary air.

Other features: minimum space requirements, quiet operation, sustained high fineness, tungsten carbide faced pulverizing elements, flash dries wet coal.

RILEY STOKER CORPORATION
WORCESTER, MASSACHUSETTS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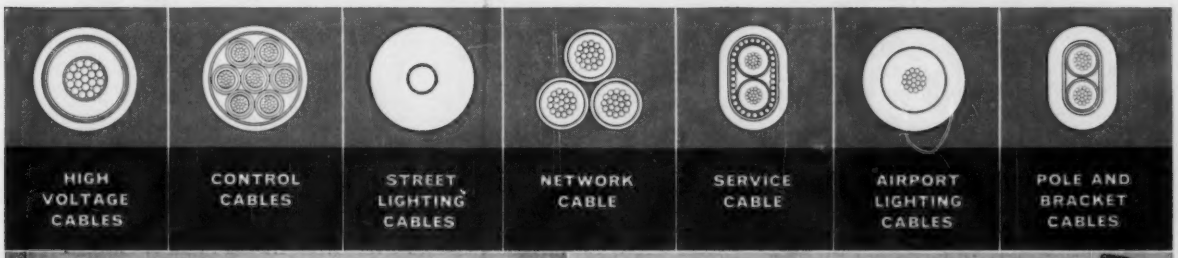
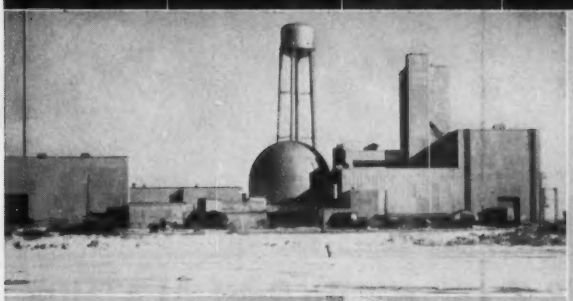
PARANITE® POWER CABLE



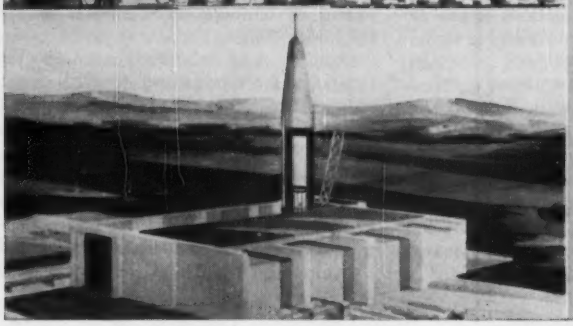


The Enrico Fermi Atomic Power Plant

near Monroe, Michigan, operated by the Power Reactor Development Company and the Detroit Edison Company. Paranite was selected to supply 600 V. network and 5,000 V. shielded cable for the nuclear section. Illustrated at right is a typical Paranite Power Cable.

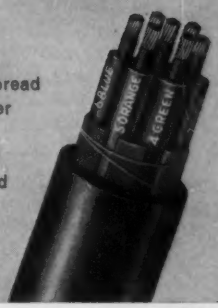
Indian River Generator Plant

of the Orlando, Florida, Utilities Commission. From transmission line . . . to power cable . . . through control cable . . . Paranite was specified to carry the load in serving this growing area. Illustrated at right is one of Paranite's complete line of 600 V. Network Cable.



Missile Bases

provide another example of the widespread and diversified use of Paranite in power distribution throughout the nation. Paranite Control Cables are produced in a complete range of insulation and jacket types. Illustrated at right is a typical Paranite Control Cable.



For more information on high voltage, control, street lighting, network, service and airport cables contact your local Paranite representative . . . or write Paranite Wire and Cable Division, Dept. 204, 2601 S. Adams St., Marion, Indiana.

Since 1890

PARANITE WIRE & CABLE DIVISION

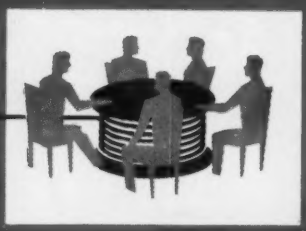
ESSEX WIRE CORPORATION, Marion, Indiana

MANUFACTURING PLANTS: Marion, Ind.; Jonesboro, Ind.; Tiffin, Ohio; Anaheim, Calif.

Sales Offices and Redistribution Warehouses in all Principal Cities

WIRE AND CABLE ROUND TABLE

DU PONT



You have asked . . .

Question: I am well aware of the advantages of ZYTEL® nylon resin as a jacket over a primary insulation. Can I use it alone as an insulation?

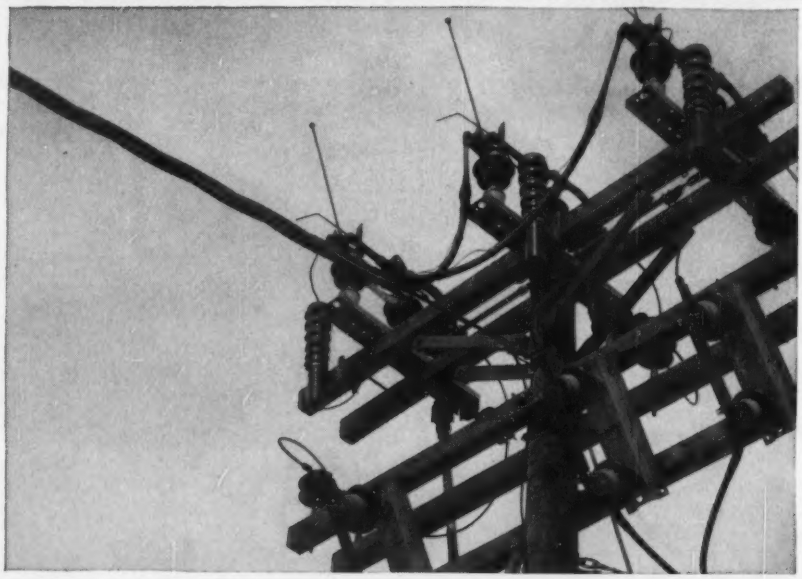
Answer: There are several constructions on which ZYTEL is used as primary insulation. Geophysical cable and blasting cap leg wire are two good examples. ZYTEL does not have the excellent electrical properties of ALATHON polyethylene resin, but can often be used to advantage where you want an exceptionally tough insulation for low voltage wiring.

Question: What about the problem of flammability with polyethylene insulation?

Answer: Polyethylene is no more flammable than many of the other materials which are in wide use today (such as paper-oil or rubber insulation). Actually we have had electric arcs in contact with polyethylene power cable insulation and jacket that melted the conductor without causing the polyethylene to propagate the flame. Where you are worried about vertical runs of thin wires, say control cable, try RULAN®.

In a recent plant fire, no damage was found in power cables located in trays directly above a severe 45 minute solvent fire. The cables were insulated and jacketed with ALATHON, in interlocked aluminum armor.

Du Pont does not manufacture wire and cable, but supplies thermoplastic resins to the wire and cable industry.



Fitchburg G & E selects Du Pont ALATHON® for 15 KV pre-assembled aerial cable

Back in 1957, Fitchburg Gas & Electric Light Company had to terminate some polyethylene insulated and jacketed cable from an industrial customer onto their power lines. This was their first exposure to polyethylene. Now Fitchburg G & E is a steady user of aerial cable protected with polyethylene.

Typical of their installations is the 15 KV three conductor pre-assembled aerial cable shown above. Designed and sold by Anaconda Wire and Cable Co., New York, this cable takes full advantage of the insulating and jacketing properties of Du Pont ALATHON polyethylene resins.

For example, ALATHON 3B, was especially designed to give the utmost corona resistance for high voltage polyethylene insulation, especially at critical bend areas. Its extremely low power factor (0.0002) and dielectric constant (2.28) do not change with temperature or time. It also offers high dielectric strength and absorbs virtually no moisture.

As a jacketing material, high molecular weight black ALATHON offers the combination of abrasion, chemical and weather resistance needed for aerial cable. Extremes in temperature, common in the Fitchburg, Mass., area, have no effect on the jacket. And it offers outstanding resistance to mechanical and electrical stress.

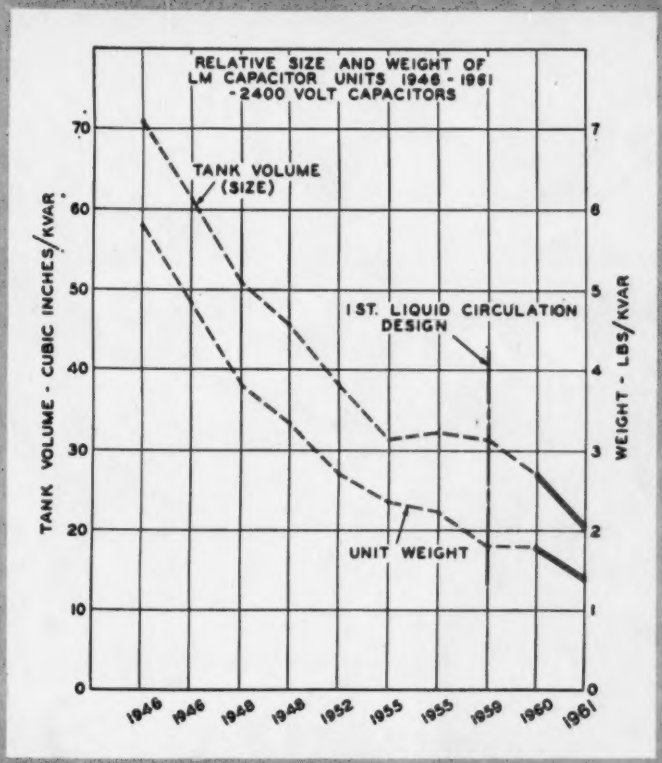
It will pay you to find out more about the economy and performance reliability offered by cable protected with ALATHON. Consult your wire and cable supplier, or write to: Du Pont Company, Dept. EW-814, Room 2507A, Nemours Bldg., Wilmington 98, Del. *In Canada:* Du Pont of Canada Ltd., P.O. Box 660, Montreal, Que.

POLYCHEMICALS DEPARTMENT

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living . *through Chemistry*

ALATHON® POLYETHYLENE RESINS | **RULAN®** FLAME-RETARDANT PLASTICS | **ZYTEL®** NYLON RESINS



ABOVE GRAPH SHOWS THE STEADY REDUCTION in relative size and weight L-M has made in capacitors throughout the years. A result of L-M's continued research and development programs backed up by expensive test facilities. The latest product, L-M's new Form 6, 50 kvar capacitor, is 17% smaller and 23% lighter. These new capacitors require less space to store, less effort to handle in warehouse and truck. Linemen will find them easier to handle and hoist.

L-M's New Lightweight 50 Kvar Capacitor Assures Ease In Handling and Installation

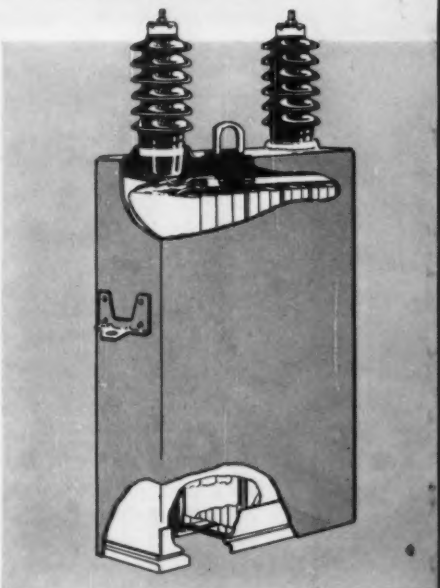
Exclusive cooling methods developed by L-M permit a smaller tank, less Elemex cooling liquid for this lightweight unit.

Line Material announces the new Form 6, 50 kvar capacitor. Another outstanding product of L-M's research and development facilities! This new unit has been greatly reduced in overall size and weight, making it much easier to store, handle, and install.

L-M's exclusive cooling method makes possible this phenomenal reduction in weight and size of Form 6 capacitors. This L-M development permits the circulation of Elemex liquid between and around the packs. Heat generated within the capacitor is carried to the radiating surface of the stainless steel tank. Heat is dissipated more rapidly. The capacitor remains cooler internally even though it is smaller.

Get Complete Information

Have your L-M Field Engineer give you complete details on this new L-M lightweight Form 6, 50 kvar capacitor. Or write Line Material Industries, Milwaukee 1, Wisconsin.



CORRUGATED SPACERS between capacitor packs circulate Elemex liquid eliminating capacitor hot-spots. Heat is quickly transferred to the stainless steel tank walls permitting radiation to surrounding air.

OUR 50TH YEAR 1911 — 1961

LINE MATERIAL® Industries

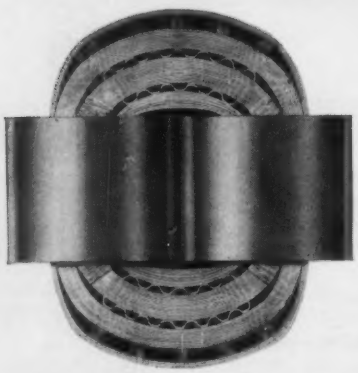
McGRAW-EDISON COMPANY

Elemex® Capacitors

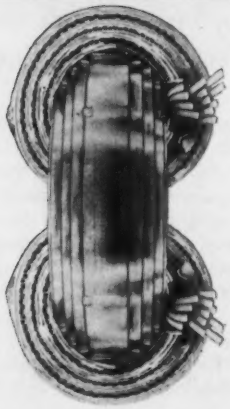
McGRAW EDISON

527

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS
LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT • PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS
OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

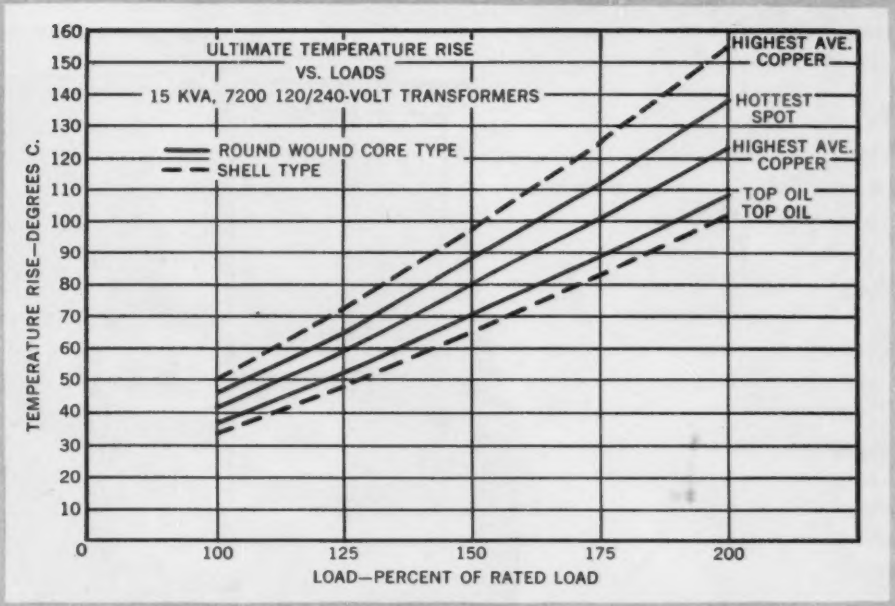


MOST TRANSFORMER MANUFACTURERS use a shell-type configuration where cooling ducts are not practical in the core window. Hottest-spot temperatures can not be maintained low enough to assure insulation life during overload periods. The result is more rapid deterioration of insulation, shorter transformer life.



L-M INCORPORATES a core-type design in Round-Wound transformers. Cooling ducts extend around the entire winding even in the core window. This provides a constant flow of cooling oil to all portions of the winding. Hottest-spot temperatures are maintained at low values for maximum insulation and transformer life.

A COMPARISON OF ACTUAL MEASURED temperatures shows how Round-Wound transformer windings are cooler than shell-type designs. Hottest-spot temperatures of Round-Wound transformers are lower than highest average copper temperatures of many shell-type designs. L-M core-type designs transport the internally generated heat out of the windings to the oil where it can be dissipated into surrounding air.



Only L-M Round-Wound® Transformers Permit Increased Overload, Guaranteed Hottest-Spot Rise

L-M bases all increased bonus ratings on maximum rise of 65° C hottest-spot temperature, not on average copper

by **A. R. Waehner**
Director,
Transformer Product
Sales
Line Material Industries

Transformer insulation life is appreciably shortened by high temperatures. This is true of both cellulosic and other insulations. Transformers fail when the insulation fails.

Thermal capacity, top oil temperatures, average copper temperatures and temperature gradients are all terms used to gauge the relationship of loading to transformer life.

Only L-M Guarantees Hottest-Spot Rise

Hottest-spot temperature rise is absolute. The hottest-spot is within the transformer winding. Maintain the hottest-spot temperature at a low value and long transformer life is assured.

Many other transformer manufacturers approve an overload percentage with temperature rises not exceeding 65° C. You should ask them *which* temperature will not exceed 65° rise! There is a difference between hottest-spot and average-copper temperatures.

Notice, L-M is the only transformer manufacturer approving up to 20% increased overload and guaranteeing maximum hottest-spot temperature. Why? Only L-M transformers can cool cores and coils sufficiently to guarantee hottest-spot temperatures at bonus rating.

L-M incorporates a core-type design in Round-Wound transformers. This design, which is used in power transformers, cools cores and coils most efficiently. It maintains hottest-spot temperatures lower than any other design. Only L-M incorporates this efficient design in Round-Wound transformers.

Most Efficient Cooling The Answer

Round-Wound designs have concentric oil ducts all around the core legs. Cooling oil reaches all portions of the windings. Hottest-spot temperatures are maintained lower than in any other type design. Insulation life is not impaired and long life expectancy is assured.

Get This Technical Bulletin

Contact your Field Engineer for complete details on the outstanding cooling qualities of L-M Round-Wound transformers. Ask him for copy of Technical Bulletin TDT-108, a paper by C. R. Acker on "Transformer Overload Capacity and Life Expectancy". Or write Line Material Industries, Milwaukee 1, Wisconsin.

OUR 50TH YEAR 1911—1961

519

LINE MATERIAL® Industries

McGRAW-EDISON COMPANY

Distribution Transformers

McGRAW EDISON

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE & CONDUIT

SAVE $414 per truck IN THE FIRST YEAR!

NEW FORD ECONOLINE VANS

Now, *you can save $312 to $433 in price* alone* on a Ford Econoline Van compared to the leading conventional half-ton panels. In addition, you can save over $100 every 16,000 miles you drive!

These savings come with a man-size truck. The Econoline's cab-forward design with welded "body-frame" gives bridge-like strength and reduces dead weight to haul over ¾-ton. Only 14 feet overall, Ford Econolines are nimble in traffic, easy to park, need less garage space. Big 4-ft. door opening (both curbside and rear) and level cargo floor provide new loading ease . . . new load workability.

Special Note To Pickup Owners: Now, you can protect your loads from weather and theft with an Econoline Van . . . yet, pay less* than for most conventional ½-ton pickups. And you can get the same $102 savings on operating expenses as shown at the right.

**Based on a comparison of latest available manufacturers' suggested retail prices*

HERE'S HOW YOU SAVE

SAVINGS ON OPERATING EXPENSES EVERY YEAR!

GAS—Econoline trucks can give 30% better gas mileage than conventional ½-tonners. Figuring 16,000 miles per year at prevailing gas prices, you save..... **$70**

OIL—Crankcase capacity is only 3½ quarts instead of 5 quarts, and the recommended oil change interval is 4,000 miles versus 2,000 miles. In 16,000 miles you save..... **$13**

TIRES—Econoline tires last longer, cost less to replace. Prorated saving for 16,000 miles as high as $53. Typical saving..... **$16**

LICENSE—In many states (not all) the license for an Econoline costs appreciably less—up to $30.40 per year. Average for all states is..... **$3**

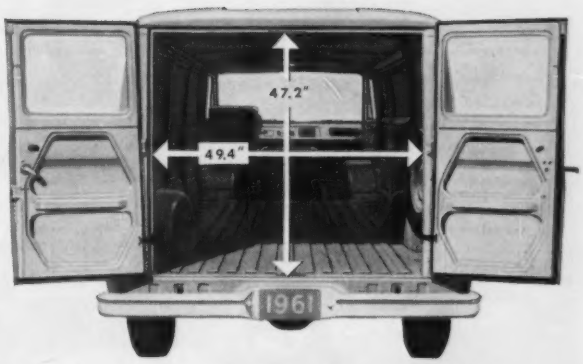
$102

SAVING ON PRICE—You can save $312 compared to even the lowest-priced popular ½-ton panel—and up to $433 against others! Saving at least..... **$312**

TOTAL FIRST YEAR SAVINGS... $414

and you keep saving

$102 EVERY YEAR!



NO REAR ENGINE HUMP!

The Econoline's "up front" engine leaves a level, knee-high floor almost 9 ft. long. There's no awkward rear-engine-housing hump to shrink the back entrance or hinder loading. And the Econoline Van provides over 204 cu. ft. of loadspace . . . up to 80 cu. ft. more than conventional ½-ton panels.

FORD TRUCKS COST LESS

SEE YOUR FORD DEALER'S "CERTIFIED ECONOMY BOOK" FOR PROOF!

FORD DIVISION, Ford Motor Company

A MAJOR CONNECTION

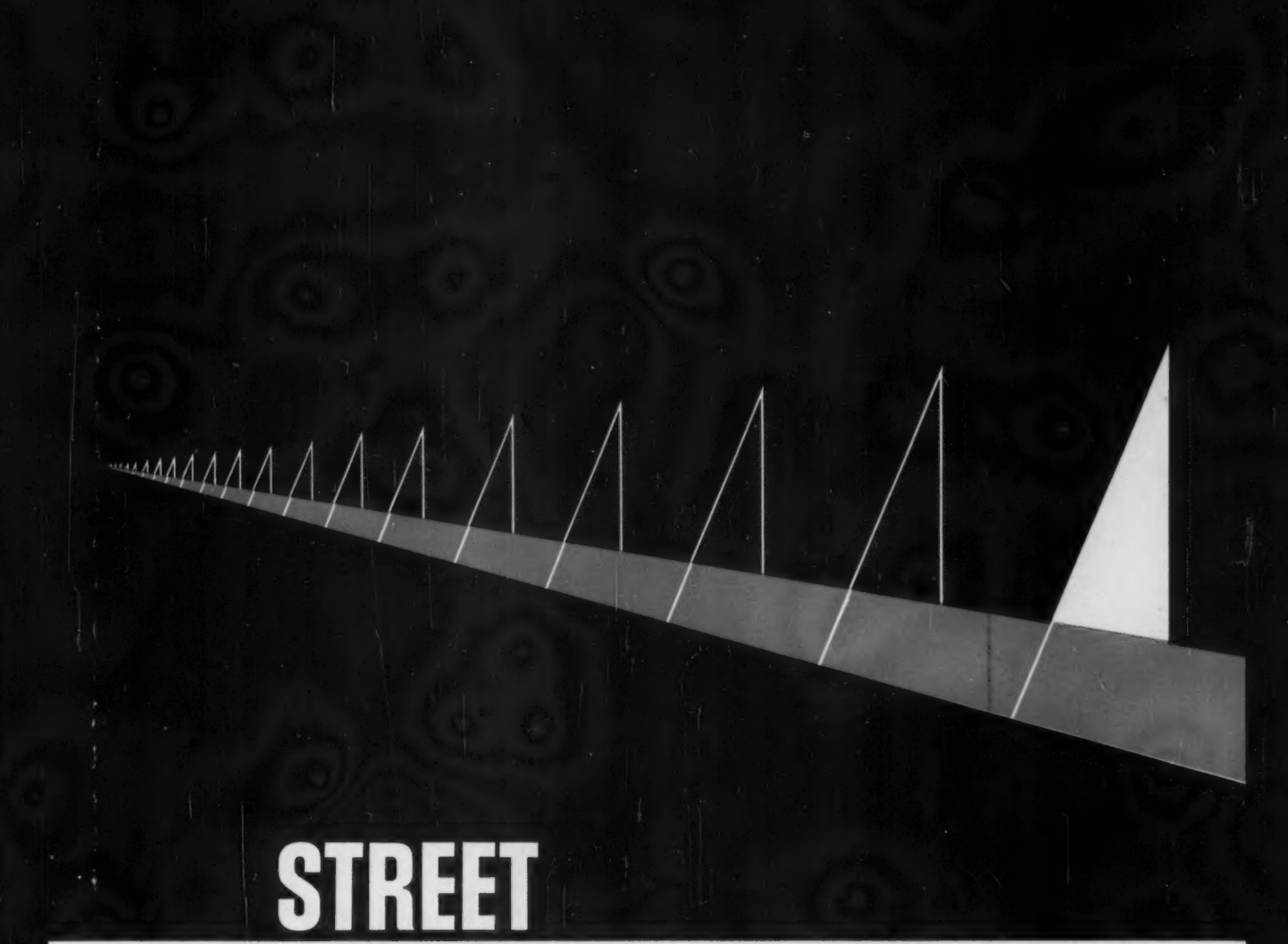
Pushing hard for completion, workmen ignore the howling blizzard as they install sluice valves in a system to purify water before the generating station converts it to steam. The skilled personnel comprising United Engineers have demonstrated on projects of every size and scope their ability to operate efficiently on schedule and within a budget. Our power specialists have designed and constructed hydroelectric and thermal plants, electric substations, and plants for supplying heating and process steam. Whatever the project—power, process or gas plant, steel mill or industrial building—we can assemble a crack team to handle it. United Engineers offers you a background of over 75 years' experience as designers, construction engineers, and engineering consultants.

Painting by Robert Lavin

Helping the power industry grow

UNITED ENGINEERS

& Constructors Inc. • U.E.&C. (Canada) Ltd. • New York • PHILADELPHIA • Chicago



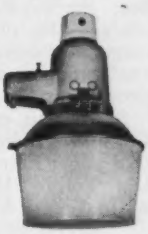
STREET LIGHTING Your billion dollar market

An ultimate utility revenue of $1 billion from street lighting is the recent forecast of one authority. Lighting of residential streets and new highways, in particular, is an area where bigger volume is an immediate prospect.

Dependable, efficient luminaires and photoelectric controls . . . products to help you realize this market . . . are the exclusive business of American Electric Manufacturing Corp. Holophane glass refractors with prismatic construction assure precise light distribution in all standard IES patterns. Spun aluminum Alzak surface reflectors give maximum efficiency from the light source. All hardware is corrosion resistant. Cast aluminum heads are manufactured to latest EEI-NEMA standards for interchangeability of optical assemblies and controls. Outstanding reliability of American Electric photocells has been proved in thousands of installations.

In street lighting equipment, American Electric is equipped to give you fast, efficient service and to handle your special requirements economically. Write today for catalog.

OPEN BOTTOM LUMINAIRE FOR RESIDENTIAL LIGHTING



Cleaning maintenance is eliminated in this modern luminaire for residential and security lighting applications. The open bottom makes it self-cleaning, and speeds re-lamping. Available for either incandescent or mercury vapor (with built-in ballast) lamps and with or without photoelectric control.

a/e STREET LIGHTING

American Electric Manufacturing Corp., 3271 Chelsea, Memphis 8, Tenn., *Representatives throughout the U.S.*

Whether used for standby or on-site portable power, electric plant breakdowns can be critical. That's why Onan is beefed up with bigger bearings, shorter-stronger connecting rods and crankshafts, and Stellite valves. *Only* Onan is Performance Certified to deliver every watt of power promised by the nameplate rating.

Only Onan is certified to give you all the power promised by its nameplate

It's a fact that many electric plants on the market today do not deliver the output promised by their nameplate rating.

Every Onan plant is given a rugged workout *under full load* before it is shipped—*your assurance* that the Onan you buy is ready for hard work the day you get it.

But this isn't enough. Independent laboratory inspectors pull surprise inspections to double-check our tests and testing methods. They pull a plant off the line, run it, stop it, load it, overload it, check and recheck. Their torture test gives positive proof of Onan's quality. End result: *Onan's exclusive Performance Certification* . . . your assurance of getting every watt of power you pay for.

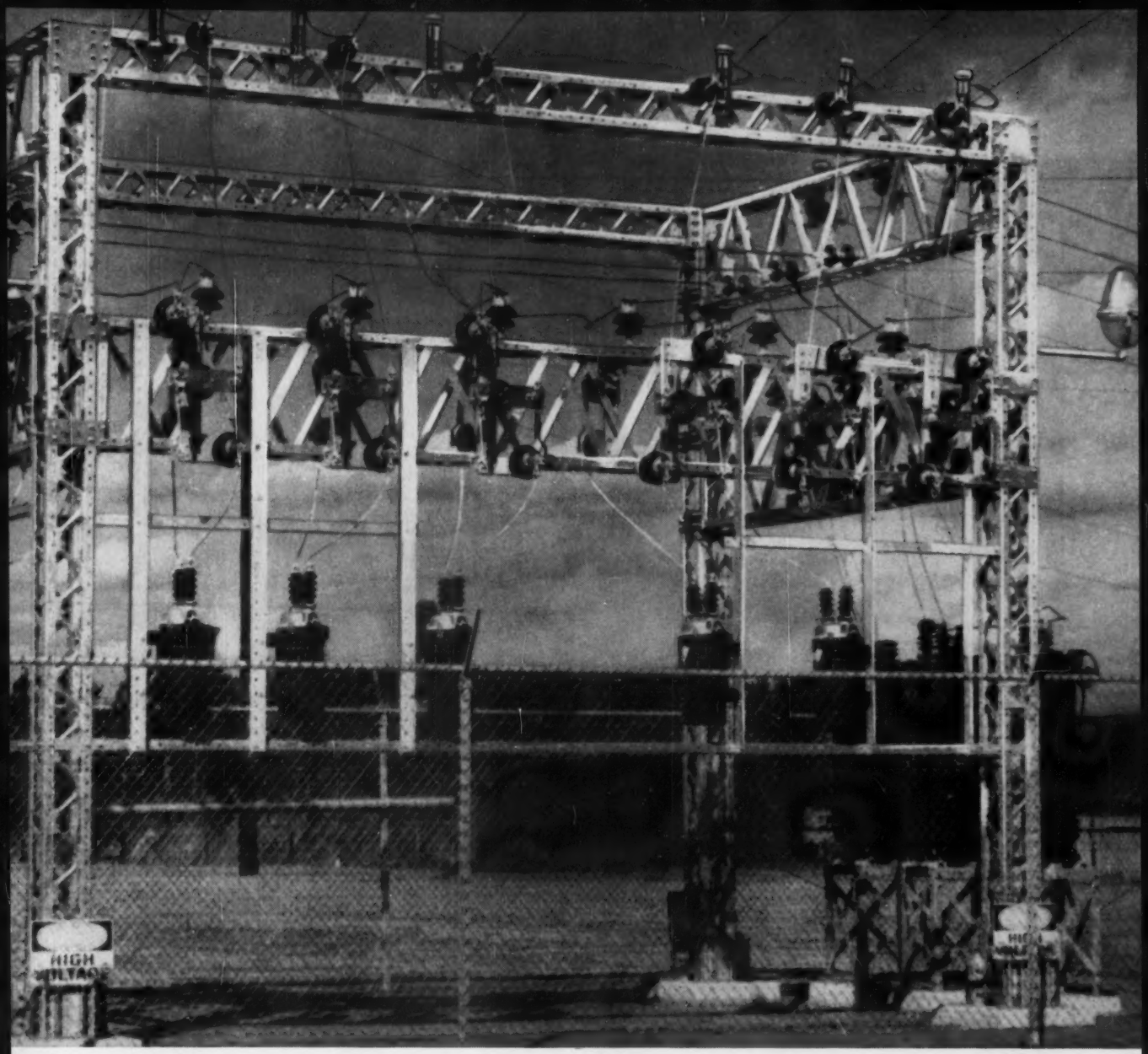
So when you're tempted by an electric plant "bargain," make sure its nameplate rating is not "inflated." Be sure you're getting full measure for your money. Remember, *the electric plant that shortchanges you in power output is no bargain at any price!* Only Onan is Performance Certified to deliver everything the nameplate promises.

See Onan electric plants soon. Compare before you buy. You'll find your Onan distributor listed in the Yellow Pages. Call him or write direct.

PERFORMANCE CERTIFIED
We certify that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.
Onan
Onan
World's Leading Builder of Electric Power Plants

Onan

ONAN Division, Studebaker-Packard Corporation, 2593 University Ave. S. E., Minneapolis 14, Minn.

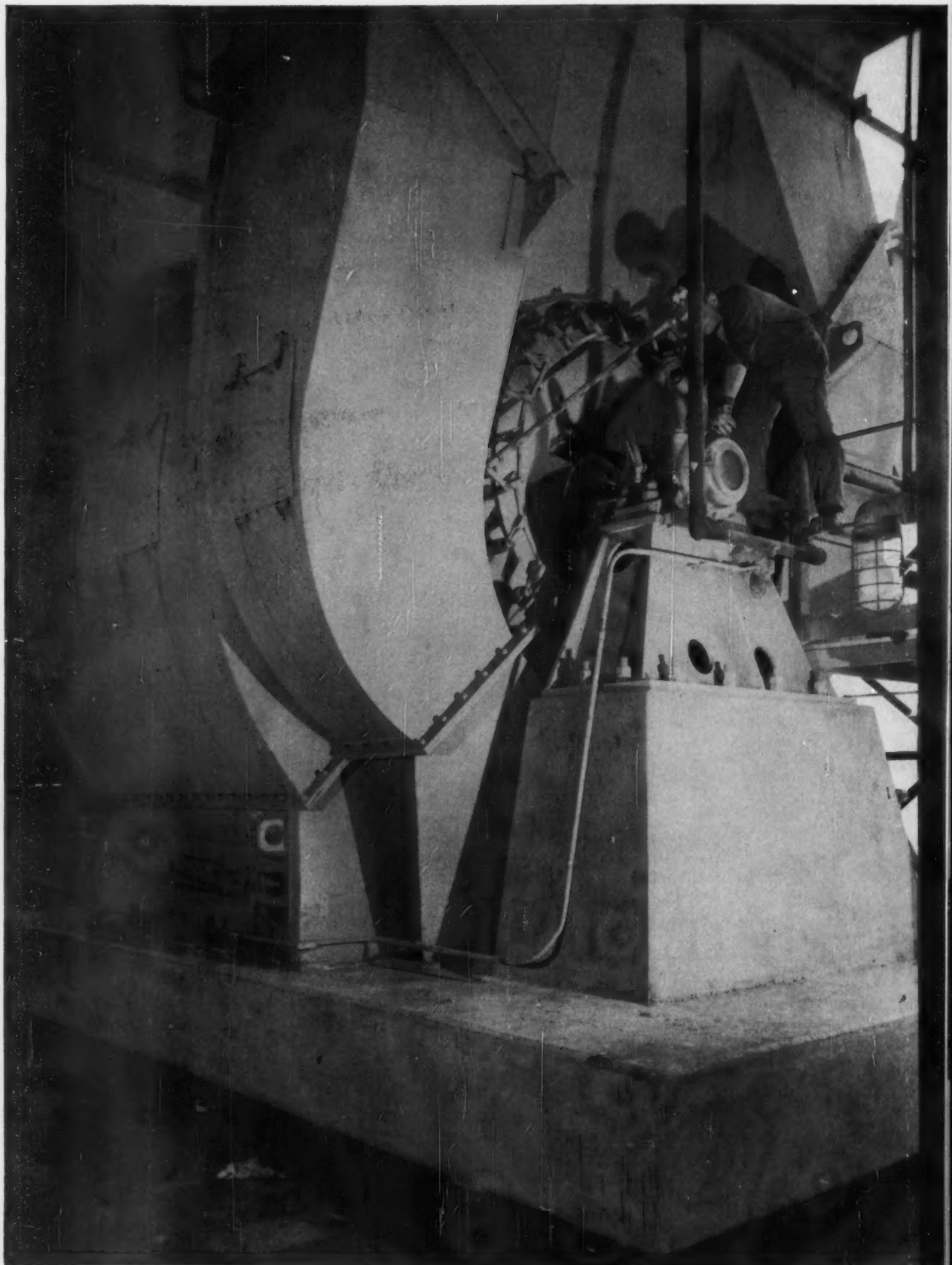


Aluminum Substation.

Substation construction has become a stand-out showplace for Olin Aluminum. Under the most difficult climatic and construction circumstances, special aluminum alloys engineered by Olin for designs by McGraw-Edison, have proved themselves in customer savings. First, aluminum substations are 50 to 65 per cent lighter than steel—with the same load carrying capacity. Field construction time can be as little as one-fourth that of identical steel structures. Second, aluminum requires no painting. Third, power interruptions, usually required for maintenance, are eliminated. Fourth, aluminum simplifies grounding —saving both materials and labor, and adding a safety factor over steel. This great versatility of aluminum in substation operations is largely to the credit of Olin Aluminum's technical research and development staff. Their genius is creative use of alloys and design to make one dollar do the work of several—through the right use of the right aluminum. This staff is at the call of your company—through your area Olin Aluminum Sales Office or the nearby Distributor.

McGraw-Edison products are marketed by Line Material Industries

Olin
ALUMINUM
400 PARK AVE., NEW YORK 22, NEW YORK



RD Fan used for induced draft on basic oxygen furnace of large steel producer. There are four identical units, each producing 325,000 cfm against a static pressure of 15" wg at 550° F.

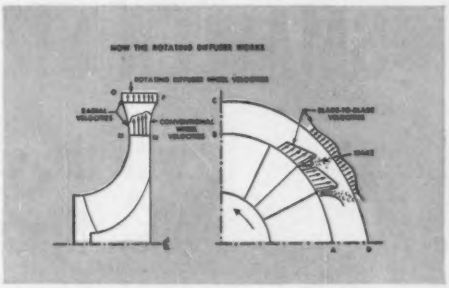
JOY RD FANS CAN PROVIDE PRESSURES UP TO 4.5 PSI AND CAPACITIES UP TO 600,000 CFM

Joy RD Centrifugal Fans, based on a new concept in fan design, can provide any volume of air or gas at pressures up to 4.5 psi in a single stage. This means important savings in initial cost. An equally important saving is their high efficiency over a wide range of volume, which is especially important where load fluctuates. Surging, even on parallel operation, is no problem because the RD Fan is inherently resistant to pressure surge over its entire duty range.

These advantages of the RD Fan are the results of its unique rotating diffuser. Instead of stationary diffusers, the RD diffuser is an integral part of the wheel—added at the blade tips. The rotating diffuser reduces the gas velocity before leaving the wheel and up to 98% of the conversion of velocity to pressure is accomplished with the wheel of the RD Fan.

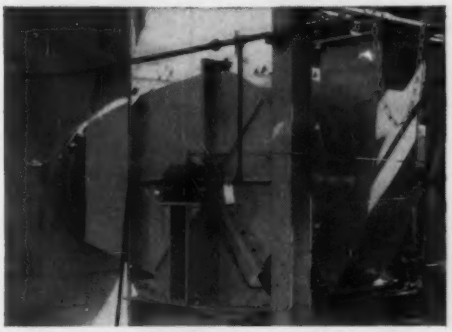
Radial blades in the RD Fan tend to be self cleaning, even when handling dust laden and dirty gases. The rotating diffuser results in low noise levels because of the lower and more regular velocities leaving the wheel and because the blade tips are remote from the cut-off.

The Joy RD Fan is finding steady acceptance in induced draft and forced draft applications in the steel and power industries, in handling chemical process gases, and in heavy duty industrial applications. For extremely dirty or corrosive applications the entire unit may be fabricated of stainless steel. Parts are simple because there are no large castings or close running tolerances. For complete information and duty areas of the RD Fan, write for bulletin 3449-97.



HOW THE ROTATING DIFFUSER WORKS

Studies have shown that radial velocities leaving conventional wheels are unequally distributed, as shown in MN. Also there is fluctuation in the blade-to-blade velocities based on $\frac{nN}{60}$ where n is the number of blades and N is the speed in rpm. The Rotating Diffuser reduces the gas velocity before leaving the wheel, which allows more uniform flow as shown at OP and CD. Without the rotating diffuser, velocities are much higher and erratic as shown at AB and MN, causing turbulence, friction losses.



Joy RD Fan at eastern CO_2 plant. Unit has capacity of 27,800 cfm, at 3 psi. Drive is a 450 hp steam turbine.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY

JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

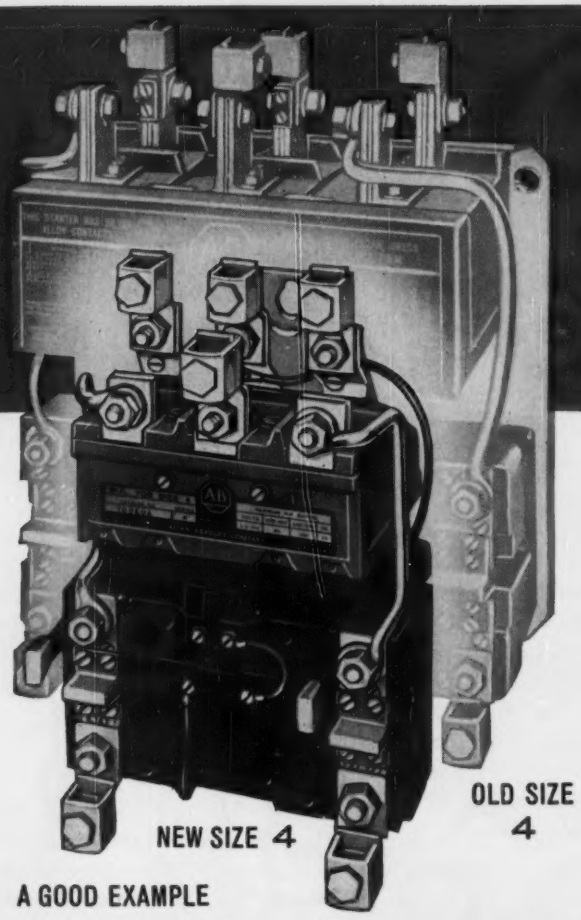
In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

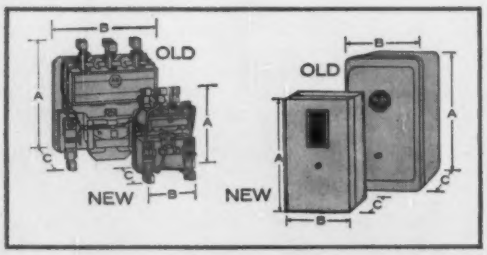
A-B QUALITY

You get BIGGER PERFORMANCE

Plus SMALLER SIZE

with the new Allen-Bradley Bulletin 709 Starters





The new revolutionary Bulletin 709 motor starters are surprisingly small in size—yet, they are good for many more millions of operations—without trouble or maintenance! Rating for rating, they have no equal. They are today's best starter value—and they cost no more!

The "Quality" you've come to expect in all Allen-Bradley control is represented in all details—especially in the "eye appealing" enclosures styled by the world famous industrial designer, Brooks Stevens. Write today for details of the new Bulletin 709 line—the greatest advance in motor control in 30 years: *Allen-Bradley Co., 1327 South First Street, Milwaukee 4, Wisconsin.*

Check These New SPACE-SAVING Dimensions

Starter Size	OPEN TYPE STARTERS						NEMA 1 ENCLOSURES					
	Height A		Width B		Depth C		Height A		Width B		Depth C	
	NEW	OLD	NEW	OLD	NEW	OLD	NEW	OLD	NEW	OLD	NEW	OLD
00	4 1/8	—	3 7/8	—	3 11/16	—	7 11/16	—	4 7/8	—	4 1/2	—
0	5 7/8	5 5/8	4 1/8	4 3/4	3 11/16	3 1/4	9 3/16	7 7/8	6 5/16	5 5/8	4 5/8	4 1/4
1	6 5/8	5 7/8	4 5/8	5	3 11/16	3 1/4	10	8 13/16	6 13/16	6 3/8	4 5/8	4 1/4
2	7 5/8	10 1/16	4 5/8	5 3/4	3 11/16	4 7/32	12	14 1/2	7 5/8	9	4 5/8	5 7/16
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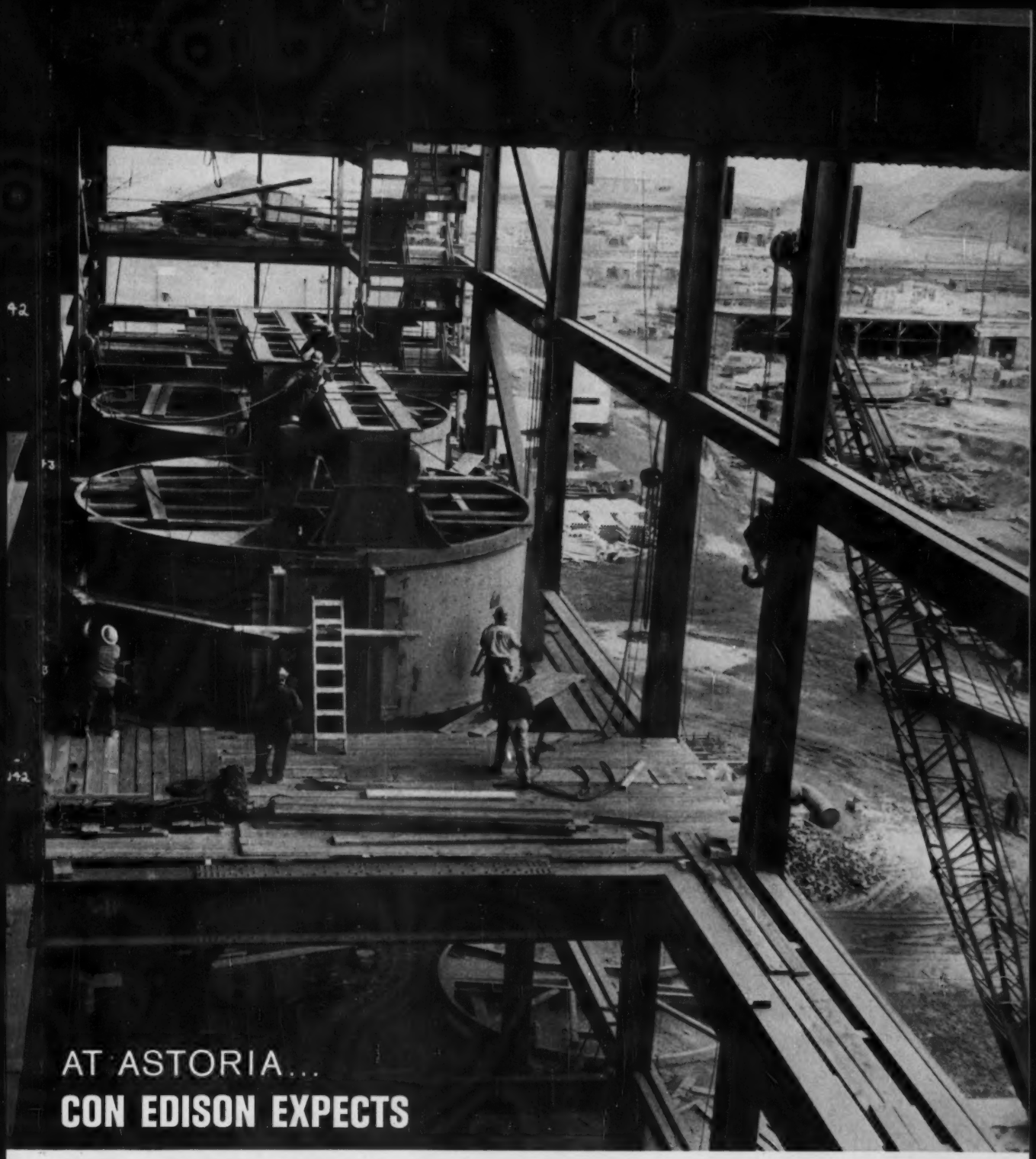
5	15 3/8	20	9 1/2	16 1/8	8 5/8	8 3/4	32 7/8	41 1/2	17 3/16	19 9/16	10 1/8	13 3/16

ALLEN-BRADLEY



AT ASTORIA...

CON EDISON EXPECTS

FUEL SAVINGS OF 8% FROM FOUR NEW LJUNGSTROMS®

Four new Ljungstrom Air Preheaters are being installed by Consolidated Edison Company of New York, Inc., on their Astoria Stations' #50 boiler unit. With a total heating surface of about 547,000 sq. ft., these four units are designed to reduce the stack temperature 345° F. By transferring this heat to the incoming combustion air, a fuel savings of about 8% is realized. Addition of these units makes a total of 16 Ljungstroms installed at Astoria . . . 77 either installed or on order in the entire Con Edison system.

Our engineers will be glad to recommend ways to improve your operating results on new or existing fuel fired units. For information, please write to:

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N.Y.

Industry-proved through a quarter century of service . . . **THERE'S NO DOUBT ABOUT NEOPRENE**

Throughout New York City's most severe winter in many years, cable pulling for the new lower level addition to the George Washington Bridge continued with few interruptions. Even sub-zero cold does not impair the pliability of neoprene jacketing. Power cable supplied by Hatfield Wire and Cable Division, Continental Copper and Steel Industries, Inc.

NEOPRENE JACKETED CABLE TO LIGHT NEW LOWER LEVEL OF GEORGE WASHINGTON BRIDGE

Chosen for its outstanding weather resistance and time-proven reliability, jacketing of neoprene synthetic rubber will protect all the power cable used to illuminate the new 6-lane lower level of the George Washington Bridge. Much of the original electrical cable installed on the bridge's upper level is being replaced too . . . and this new cable is also jacketed with neoprene.

Neoprene's widespread use for such important jobs is backed by more than 25 years of dependable service in the wire and cable industry. As a jacketing material, neoprene is tough and abrasion resistant. Combine these qualities with its inherent resistance to weathering, temperature extremes, flame, hot and cold flow, and you have the important reasons why neoprene jacketing means long, reliable protection for electrical cable. For your free subscription to the WIRE AND CABLE CASEBOOK, containing news about applications of neoprene in the electrical industry, write: E. I. du Pont de Nemours and Co. (Inc.), Elastomer Chemicals Department EW-8, Wilmington 98, Delaware.

DU PONT
REG. U. S. PAT. OFF.

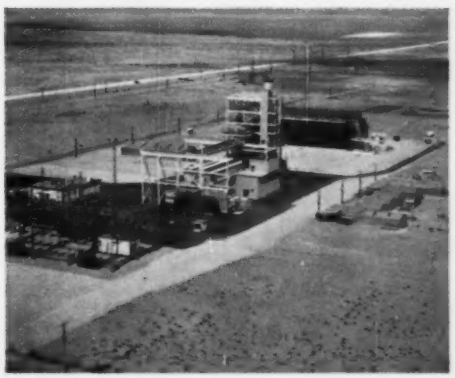
NEOPRENE
SYNTHETIC RUBBER

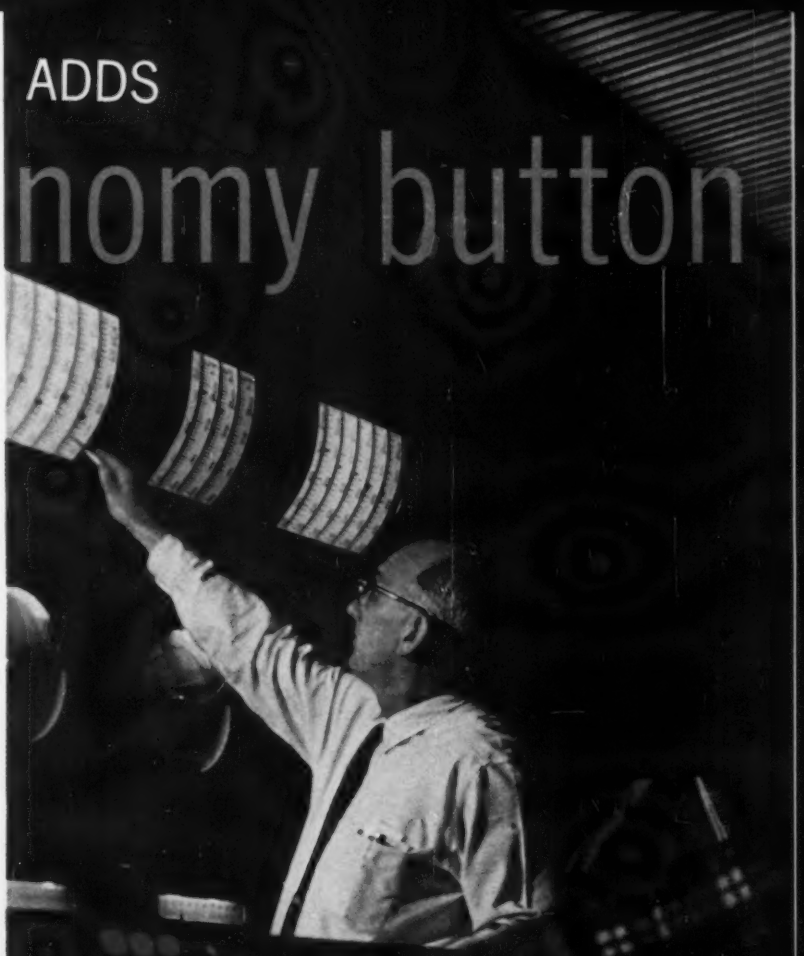
Better Things for Better Living . . . *through Chemistry*

STONE & WEBSTER ADDS
the economy button

Significant economy in the design and construction of power plants — whether steam, hydro or nuclear — is achieved through an accumulation of economies effected all along the line, from site selection to completed project.

Stone & Webster has gained and maintained leadership in power engineering precisely from our ability to produce such economy in completed plants that have established records in both performance and safety. This ability is available to you. Let us discuss your future power requirements.

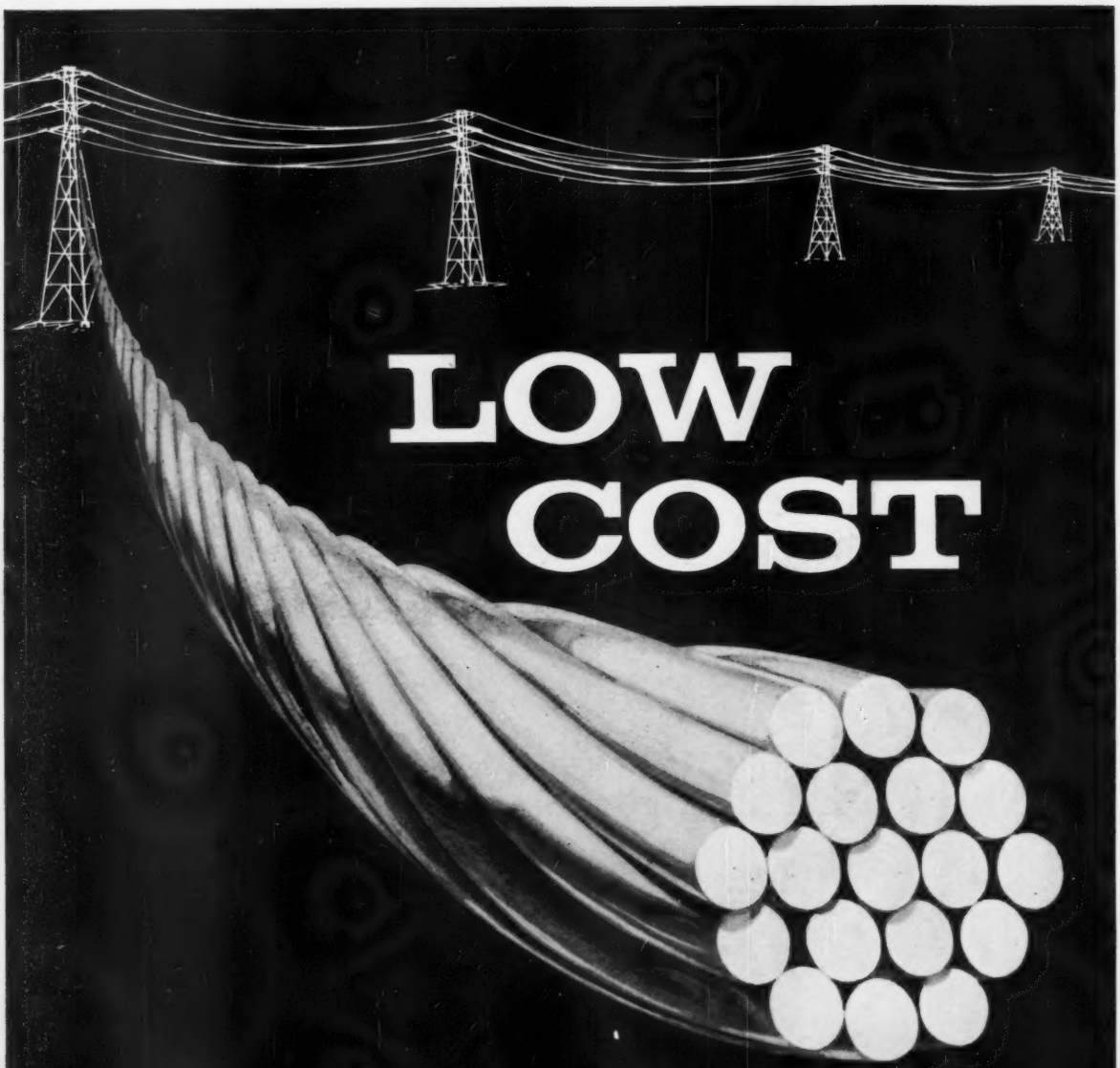




STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

New York, 90 Broad Street Boston, 49 Federal Street Chicago Houston San Francisco Los Angeles Seattle Toronto Calgary



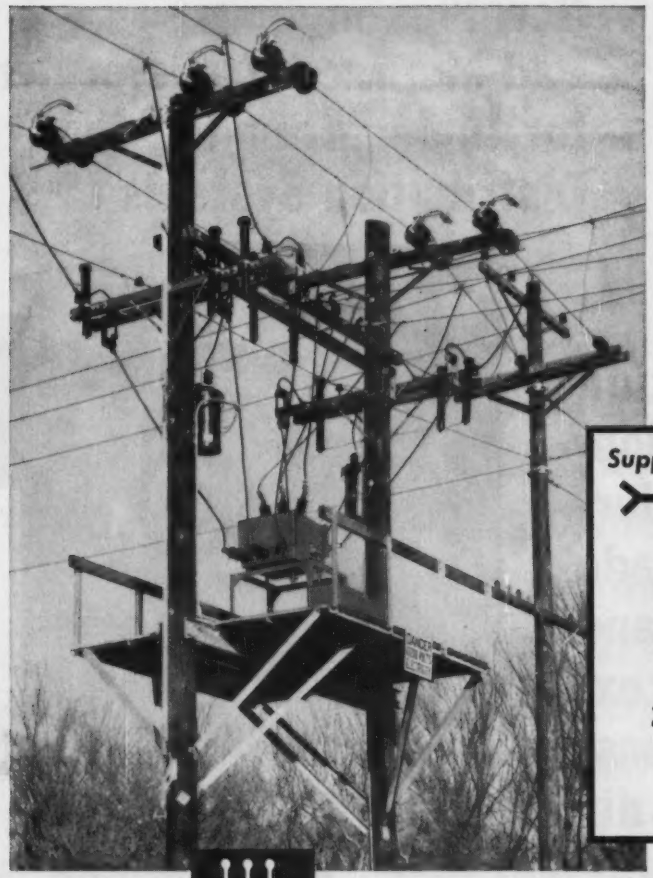
LOW COST

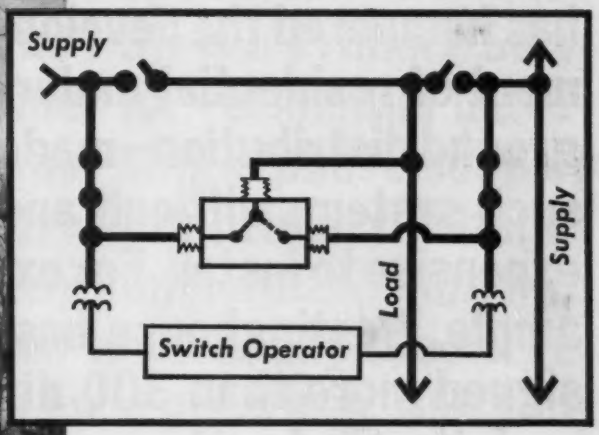
REYNOLDS 5005

high strength, all-aluminum conductor

Reynolds 5005 costs less than any other conductor with comparable properties. You get lower power losses . . . improved voltage regulation . . . increased current carrying capacity. Minimum guaranteed conductivity 53.5%. And 5005 is also light in weight—stringing and handling costs are lower. It has no steel core, thus is easy to splice and there is no chance of galvanic corrosion. Complete data available from your nearest Reynolds branch office, Reynolds Electrical Distributor, or *Reynolds Metals Company, P. O. Box 2346-EL, Richmond 18, Virginia.*

Watch Reynolds TV show "Harrigan & Son", Fridays—ABC-TV





G&W Load-Break Oil Switches Are Excellent For Overhead Sectionalizing

All the well-known advantages of G&W Type RA Standardized Load-Break Oil Switches on underground systems are equally as effective on overhead lines. Complete system flexibility, reliability, immunity to weather, and automatic or manual operation are provided by G&W Type RA Switches in switching and sectionalizing loaded overhead secondary and primary circuits from 600 volts through 15 kv. Type RA switches are available with topmounted bushings or with cable entrances for aerial work as desired.

Illustration and diagram show how one utility provided automatic transfer for an important load using a G&W Type RA load-break oil switch. A G&W Model "F" automatic operating mechanism selects and throws the switch to preferred or auxiliary feeds as may be required so as to keep the load alive so long as either feed is energized. Two- and three-way Type RA switches are also available from G&W for direct pole mounting with groundlevel manual operating handle.

G&W Standardized Type RA Load-Break Oil Switches are conservatively rated at 400 amperes continuous duty and will break full load current. BIL and 60-cycle test voltages are equal to full power levels.

Write to G&W for further information on Type RA Standardized Load-Break Oil Switches or contact your nearest G&W representative.

G & W ELECTRIC SPECIALTY COMPANY
3500 WEST 127th STREET • BLUE ISLAND, ILLINOIS
CANADIAN MFR. • POWERLITE DEVICES LTD. • TORONTO, MONTREAL & VANCOUVER

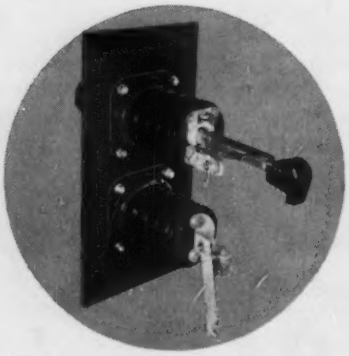
superior quality standards — inspired specialized design

D61-5

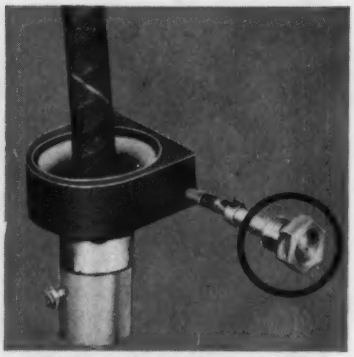
New Westinghouse Pad-Mounted Transformer for Underground Distribution Systems

Lack of standardization has hampered the development of residential underground distribution—made such systems difficult and expensive to install. For example, Westinghouse has designed more than 300 different variations of pad-mounted transformers—which is costly both to the user and the manufacturer. After several years' study of customer needs, Westinghouse announces the PSP—a complete transforming-

Westinghouse Primary Service Pad-Mounted Transformer, with optional provision for customer service meters. Main cover can be opened only from inside. Transformer compartment is located directly behind HV and LV terminal compartments. Accommodates 10 through 50 kva transformers interchangeably with same compartments. Detachable cover assembly interlocks with terminal and transformer compartments for maximum security and safety.



HV load break air switch—a Westinghouse exclusive—isolates transformer. Switch has visible disconnect blade (shown in open position), will safely interrupt 400-amp load current. Interrupter switch and disconnect are mechanically interlocked.



Built-in fault detector is an exclusive optional feature. Magnetic pickup type indicator shows location of fault when cabinet is closed. Note indicator button at base of cabinet in main view above.

J-70869

switching-protecting package specifically designed for underground service. The PSP is a Primary Service Pad-Mounted Transformer for residential underground distribution systems—single phase, loop or dual feed, 10 kva to 167 kva with primary voltages up to 15 kv. It is a completely standardized unit, with optional features engineered to meet any special requirements or variations in local practices. Ask your Westinghouse sales representative to show you how the new PSP transformer can simplify your next underground job—from the planning stage to the finished installation. You can be sure . . . if it's Westinghouse.

Exclusive Westinghouse design includes factory-built stress cones, providing convenient termination for shielded cables instead of old-fashioned, laborious hand wrapping.

LV terminal compartment at right encloses optional CSP breaker handle and terminal block for customer service leads. Four-hole spade terminals provide for multi-circuit connections. HV and LV compartments are separated by barrier. LV door can be padlocked. Inside catch releases HV door.

Westinghouse

NEW PG&E UNITS PIPED BY MIDWEST

Pacific Gas and Electric Company, serving the rapidly growing region of Northern and Central California, has added 3,615,500 KW of steam plant capacity since World War II alone. Another 720,000 KW is scheduled for completion by mid-1963. Midwest is proud to have been the piping fabricator and/or erector for most of the new or expanded plant capacity completed to date or under contract, and to have been selected as the fabricator and erector for PG&E's newest project—units 3 and 4 at Morro Bay Station. In all, PG&E will have 26 generating units in 7 plants benefiting from power piping by Midwest!

For an illustrated booklet on Midwest's capabilities in piping, write for Bulletin 60B, POWER AND PROCESS PIPING.

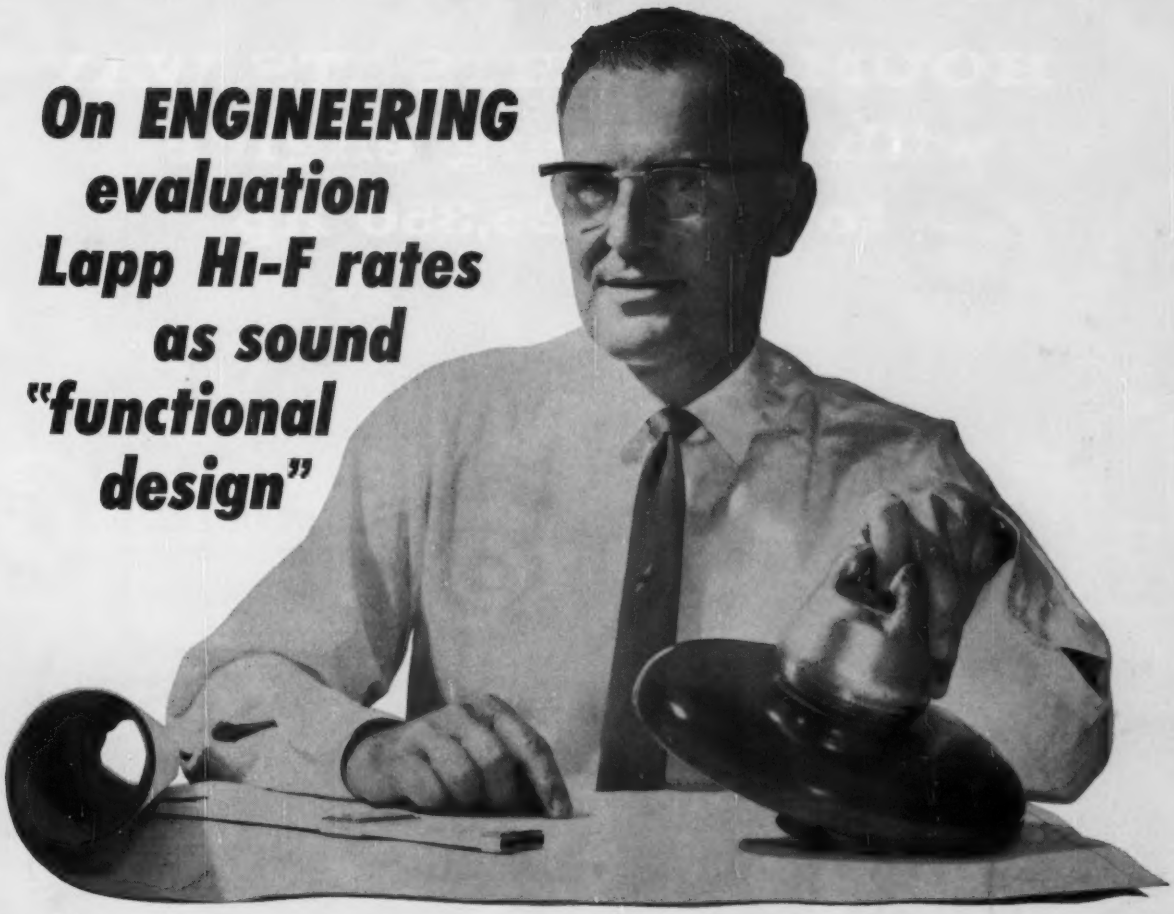
PG&E's new 1,320,000 KW Pittsburg Power Plant. At left are units 5 and 6 (660,000 KW) for which Midwest recently completed the piping fabrication and erection.

A Division of Crane Co. / *1450 South Second Street, St. Louis 4, Missouri*

MIDWEST PIPING

8144

On ENGINEERING evaluation Lapp Hi-F rates as sound "functional design"



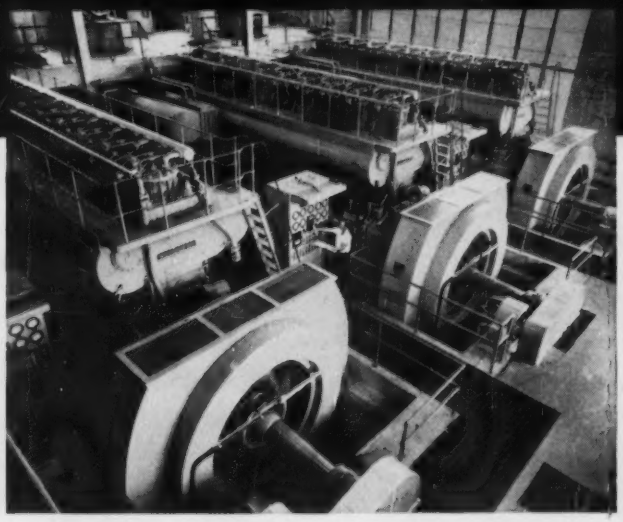
"In engineering, we don't think there's much more sense to over-design than there is in under-design. We rate as "most efficient" that transmission line design that comes closest to matching up the strength characteristics of conductor, structure, hardware and insulators.

"Most of our transmission system is designed for a working load of only a few thousand pounds. Lapp Hi-F, with an M&E strength rating of 14,000 lbs., is an up-to-date 'compact model' suspension insulator. Because it satisfies our engineering requirements, and saves the company money, it goes on our standards list pronto!"

There's no compromise with quality in Lapp Hi-F—only a reduction in size and weight (and a more realistic relationship between rated strength values and actual performance characteristics). As compared with the NEMA standard 10" suspension insulator, Lapp Hi-F is 1" smaller in diameter, one-third less in weight, and is fully interchangeable physically. Rated at 14,000 lbs. M&E strength, Hi-F matches EEI-NEMA-52-3 in every other mechanical rating, and in every electrical characteristic. On every consideration, technical or economic, we think you too will rate Lapp Hi-F as "OK."

Lapp Insulator Co., Inc., LeRoy, N. Y.

HOUMA LIGHTS ITS WAY with Nordberg engines totaling 25,350 hp



Houma, long known as the shrimp center of Louisiana, has built its municipal power plant around Nordberg engines . . . and has eliminated the necessity for purchased power.

Power demands in Houma have grown steadily since 1949 when the first three 2,000 hp Nordberg natural gas burning engines were added to their 2,900 hp plant. Today, with only two of the original five oil burning engines in use, Houma's 15,800 kw peak load is satisfied by an additional four Nordberg units, the last three being big 10 cylinder, dual fuel engines rated at 5,250 hp each.

When *you* need *long term, dependable* power, consult Nordberg. See why there are so many *repeat orders* like those for the City of Houma for Nordberg Diesel, Duafuel, and Spark-Ignition gas engines, in sizes to over 12,000 hp.

INSTALLATION DATA:

1949—Installed 3 Nordberg 2,000 hp engines.
1954—Installed Nordberg 3,600 hp engine.
1959—Installed 3 Nordberg 5,250 hp Duafuel engines.

NORDBERG MANUFACTURING COMPANY • Milwaukee 1, Wis.

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS • NEW ORLEANS • NEW YORK • ST. LOUIS
SAN FRANCISCO • TAMPA • WASHINGTON • WICHITA, KAN. • TORONTO • VANCOUVER • JOHANNESBURG • LONDON • MEXICO, D. F.

NORDBERG MACHINERY

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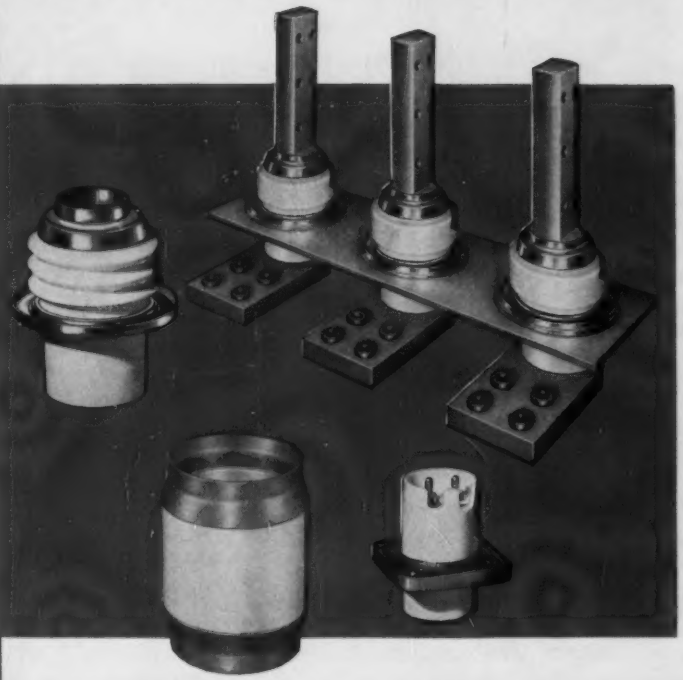
P159

ALITE® HIGH-ALUMINA HERMETIC SEALS AND BUSHINGS

Combine...

- VACUUM-TIGHTNESS
- SUPERIOR MECHANICAL STRENGTH
- HIGH TEMPERATURE AND HEAT-SHOCK RESISTANCE
- RELIABLE ELECTRICAL CHARACTERISTICS
- HIGH RESISTANCE TO NUCLEAR RADIATION
- PRECISION TOLERANCES



Transformer bushings (both high and low voltage) . . . underground cable insulators . . . power cable end seals . . . switchgear contact insulators — these are just a few of the places where Alite is solving reliability and maintenance problems for the electrical industry.

With maximum working temperatures in the range 1300°-1600°C., Alite can be metallized and brazed to metal parts to form rugged, vacuum-tight seals which, in turn, can be welded into final assemblies.

From design to finished part, every manufacturing step — including formulating, firing, metallizing and testing — is handled within our own plant and carefully supervised to assure strict adherence to specifications, utmost uniformity and reliability.

★ ★ ★ ★

The Alite parts and products listed at the beginning of this advertisement are typical of the special design problems on which Alite engineers stand ready to help. In addition, over 100 standard sizes of Alite bushings in a range of types are also available to simplify design problems, speed delivery.

Write for FREE Helpful Bulletins

Bulletin A-7R provides detailed description and specifications of Alite. Bulletin A-40 describes Alite facilities and complete line of standard bushings.

ALITE DIVISION

U. S. STONEWARE

BOX 119 ORRVILLE, OHIO

389-G

DON'T LET "LINEMAN FATIGUE" ROB

Here's how the Kearney Power-operated Tool works

After correctly positioning the Kearney Power-operated Tool on the connector, the lineman squeezes a small rubber bulb conveniently attached to his belt. Air pressure from the bulb closes a switch to start a small motor-driven hydraulic pump on the ground. High-dielectric hydraulic fluid flows through a non-conducting pressure hose, advancing the ram and closing the dies to make the indent. To retract the dies, the lineman simply releases his finger pressure on the bulb.

An optional hand switch control is also available which permits an operator on the ground to control the pump on signal from the lineman making the installation.

YOU OF VALUABLE MAN-HOURS!

Kearney Power-operated Tools take the "muscle" out of compression installations, increase work output, reduce labor costs... and often pay for themselves in a month or less!

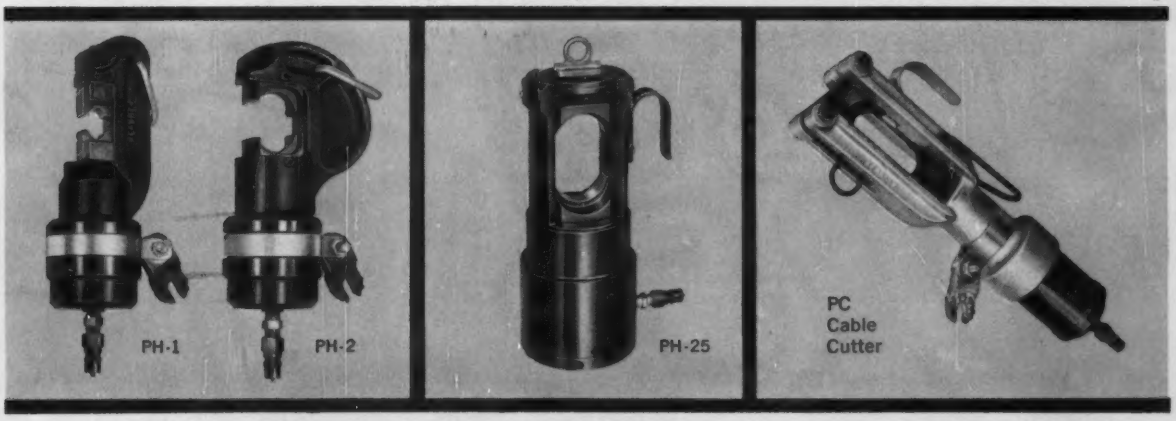
Kearney Power-operated Hydraulic Compression Tools make fast, light work of any compression fitting installation... *hot* or *cold*. By simplifying installation and reducing lineman fatigue, Kearney Power-operated Tools enable power companies to effect sizeable reductions in compression connector installation costs.

In use, the lineman merely positions the Kearney Tool on the connector and squeezes a small rubber bulb to actuate a portable motor-driven hydraulic pump on the ground below. The Kearney Power-operated Tool does the rest, without further lineman effort other than to reposition the tool for the next indent. Complete compression of the fitting can be made in less than 30% of the time ordinarily required by a lineman using the most efficient hand-operated tool.

Kearney PH-1 and PH-2 Power-operated Compression Tool Heads and the Power-operated Cable Cutter can be hotstick-mounted to make installations on energized conductor... or they can be hand-held for cold work. Using Kearney hotstick-mounted Power-operated Tools, linemen can install connectors, deadends, or sleeves... and cut ACSR or standard conductor up to 1½" in diameter... at *any* angle... with greater speed... at greater distances from the pole... and with greater safety when working on energized lines ... than has ever before been possible with hand-operated tools.

An investment in Kearney Power-operated Hydraulic Compression Tools will quickly pay for itself in labor savings and increased work output. A demonstration will convince you.

Three Tool Heads and a Powerful Cutter Head, interchangeable in seconds without tools, offer unlimited versatility



The Kearney PH-1 and PH-2 power-operated indenting heads shown above use the same dies as Kearney WH-1 and WH-2 hand-operated hydraulic tools... differ only in their maximum working ranges. For instance, the PH-1 Tool accommodates a range of aluminum Squeezon compression connectors for wire sizes up to a maximum of 4/0 ACSR or strand, while the PH-2 installs Squeezons on conductors as large as 397.5 ACSR or 400 strand. Dies may be easily inserted or removed without tools.

The Kearney PH-25 Tool Head installs a full range of compression fittings, from the smallest Squeezon up to a maximum of 1,192.5 MCM. With this tool a wide variety of fittings can be compressed with half the number of indents normally required using other types of tools. Tool develops 21 tons of thrust. Cutting dies are available for use with the PH-25 to cut conductor up to 1,500 MCM.

The Kearney Power-operated Cable Cutter cuts any type of conductor up to 1½" diameter, in 30 seconds or less. Saves many valuable man-hours otherwise lost in hand-sawing. Produces a clean-edged cut... saves deburring. Cutter may be hand-held for cold operation or hotstick-mounted for use on energized lines. Cable cutter and PH-1 or PH-2 Tool Heads can be interchanged in seconds. Cutter can also be used to cut ground rods, guy wires and like materials... on the ground... or on the pole.

For complete information contact your Kearney Sales Representative

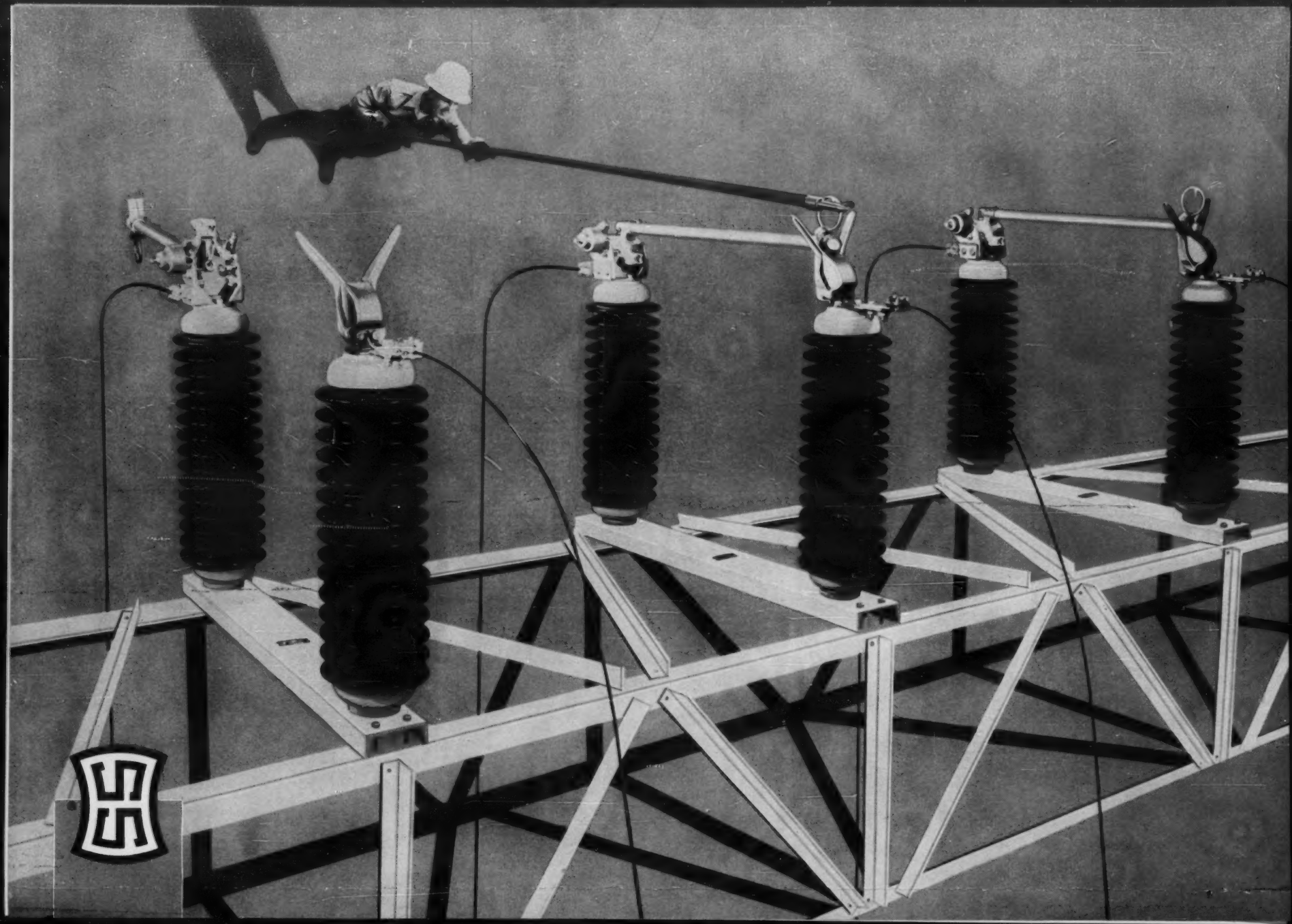
for better construction... safer maintenance... specify KEARNEY products

KEARNEY **JAMES R. KEARNEY CORPORATION**

4224-42 Clayton Avenue • St. Louis 10, Missouri

814

PLANTS AT: ST. LOUIS • MELROSE PARK, ILLINOIS • FAYETTEVILLE, ARKANSAS • GUELPH, ONTARIO, CANADA • ST. THERESE, QUEBEC, CANADA



DON'T OVERLOOK THE MECHANICAL CHARACTERISTICS WHEN EVALUATING YOUR POWER FUSES

Thermal and electrical characteristics rightfully deserve first consideration in evaluating power fuses, because the fuse must carry rated continuous current and interrupt rated short circuit currents to perform its primary function.

But from an operating and maintenance standpoint, the fuse's mechanical characteristics should not be overlooked. Here are nine of the most important features to consider:

1. **OPERATING RING** Can the fuse holder be easily disengaged from the latch? It is important that the operator have complete control over the fuse holder during the opening procedure. Southern States BPA and HPA fuses have full-circle operating rings to assure complete control.

2. **FUSE HOLDER REMOVAL** Can removal or replacement of the fuse holder be accomplished easily and simply? Special, cumbersome, rigs are objectionable to operating personnel. Southern States fuse holders are handled with a hookstick.

3. **SLEET HOOD** Are the top contacts fully protected from freezing rain, snow, or other foreign matter? Note the extra large hood on Southern States fuses.

4. **POSITIVE HOLDER GUIDE** Will the fuse holder make proper engagement with the top contact, even when closing is made from an oblique angle? Southern States fuses are equipped with generous guide arms on the sleet hood to position the holder properly, regardless of side thrust.

5. **POSITIVE IDENTIFICATION** After operation, does the position of the fuse clearly indicate that an operation has taken place? Southern States fuse holders swing to a fully open position and can be easily spotted from a distance.

6. **SHOCK ABSORPTION** After operation, does the fuse provide a sure means for bringing the fuse holder to a cushioned stop? Damage to the fuse mounting is prevented on Southern States fuses by properly designed snubbers.

7. **LINK PROTECTION** When the fuse holder is slammed closed, is there some means to prevent overstressing the link? To avoid the possibility of rupturing a link, mechanical locks on the BPA and HPA fuses absorb force transmitted through the bottom hinge assembly.

8. **RESTORING SERVICE** Is the fuse easily and economically restored to service after operating? Fuses that require elaborate replacement components to keep them in service are not only costly, but burdensome to both supply and operating personnel. A simple, inexpensive fuse kit is all that's needed to restore service with Southern States power fuses.

9. **SELF-LOCKING HINGE** When the fuse operates, are the fuse holder and fuse mounting locked together? For safety reasons and to avoid possible damage to nearby equipment, Southern States fuses are equipped with self-locking hinges.

Before you buy your next power fuses make certain they measure up in every respect. Southern States BPA and HPA Power Fuses will.

For complete details, consult your Southern States representative, or write direct to us.

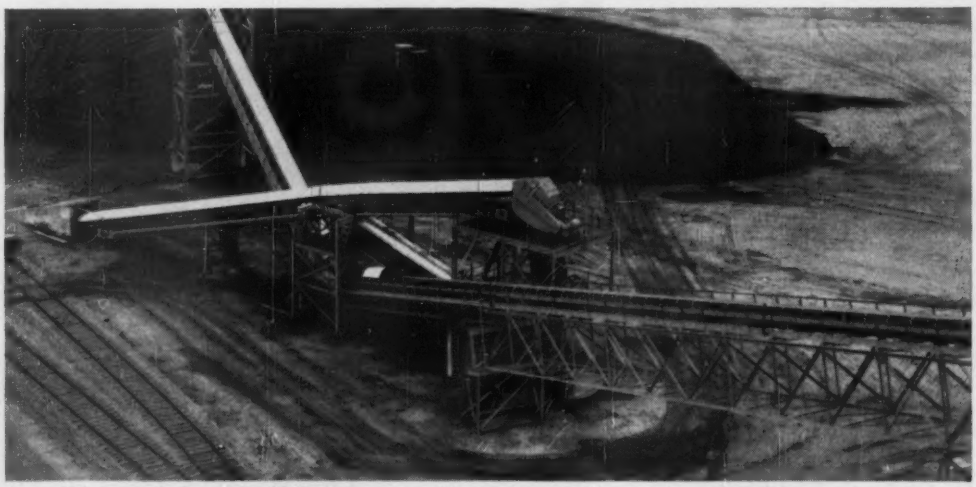
SOUTHERN STATES

HAMPTON, GEORGIA

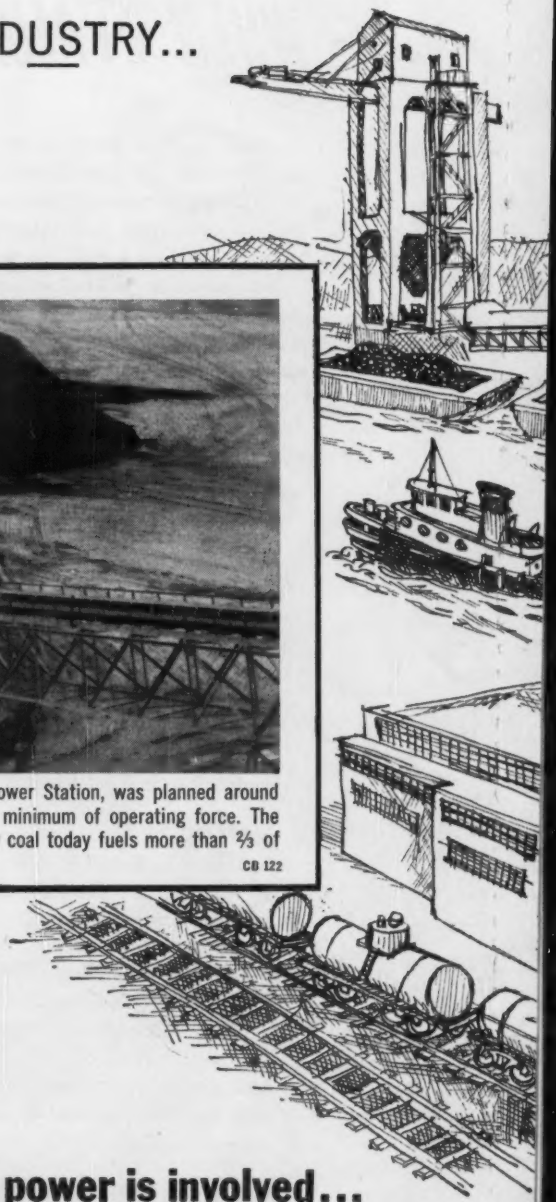
IN CANADA: DOMINION CUTOUT CO., LTD., TORONTO

US RUBBER

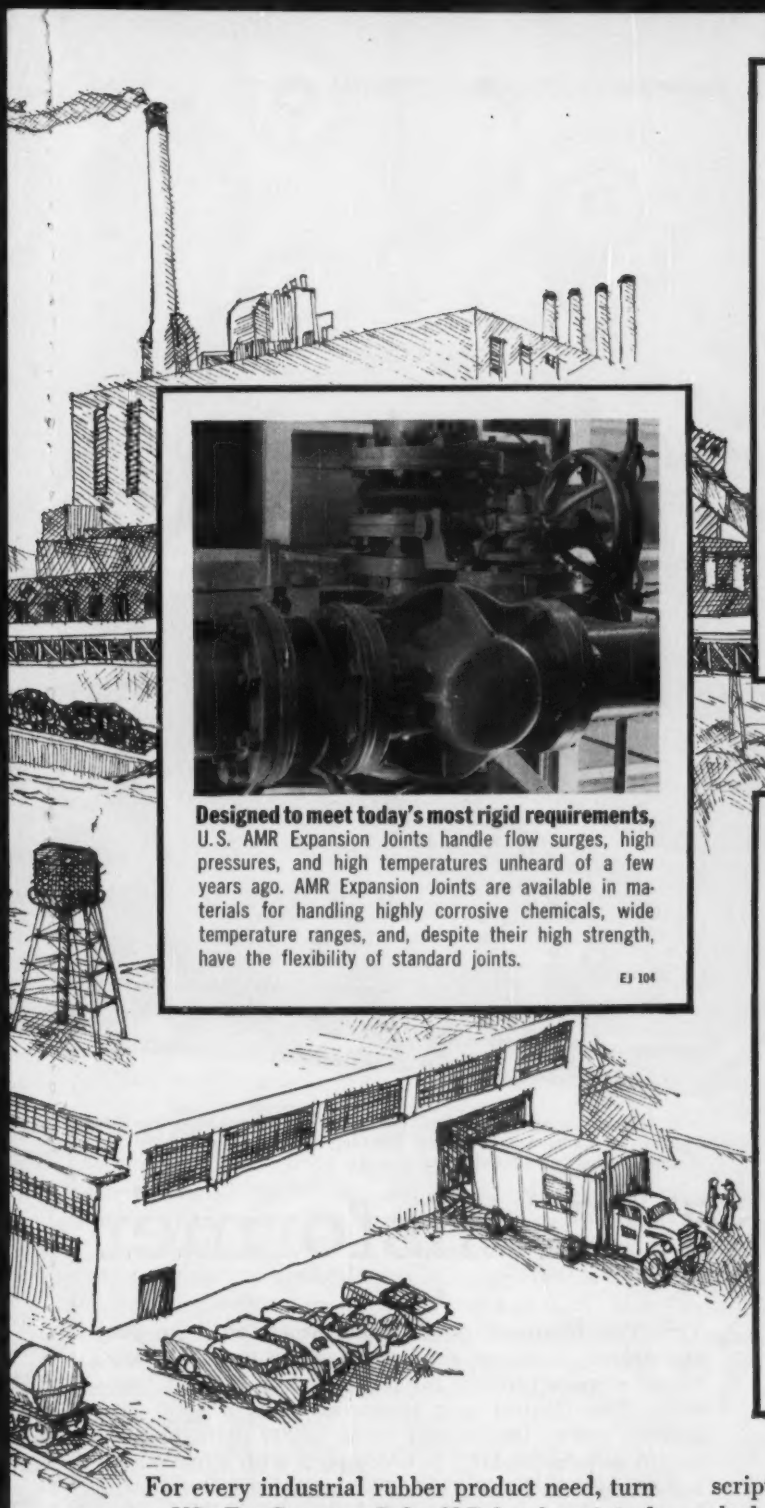
AT THE HEART OF INDUSTRY...



One of the country's most efficient power producers, the Port Wentworth Power Station, was planned around a US-designed conveyor-belt system to get the lowest cost coal handling with a minimum of operating force. The performance of US conveyor-belt systems like this one is an important reason why coal today fuels more than ⅔ of the nation's power and utility plants. CB 122



Wherever the production of electrical power is involved...
US Industrial Rubber Products are helping facilitate the conversion of mechanical and heat energy into kilowatts...more quickly, efficiently, and profitably. These US products are a good reason why electricity is the economical source of power it is.

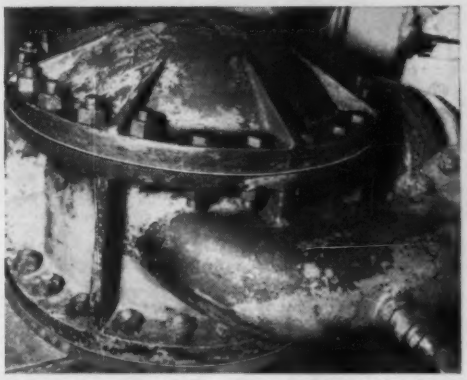


Designed to meet today's most rigid requirements, U.S. AMR Expansion Joints handle flow surges, high pressures, and high temperatures unheard of a few years ago. AMR Expansion Joints are available in materials for handling highly corrosive chemicals, wide temperature ranges, and, despite their high strength, have the flexibility of standard joints.

EJ 104

Delivering top automation and economy, 9 US Conveyor Belts provide Appalachian Power's Clinch River steam generating plant with maximum efficiency and lowest maintenance. Two U.S. Giant® Feeder Belts convey coal from the hoppers, a U.S. Giant Belt receives the feed, six other US belts help to automate this system which carries over 1,200,000 tons of coal a year.

CB 123



Most recommended for superheated and saturated steam at temperatures to 750°F., US asbestos-base Style 899 Sheet Packing also gives superior service with ammonia, gases, oils, gasoline, some acids, alkaline solutions, and other chemicals. Made of specially selected long-fiber asbestos, Style 899 Sheet Packing won't soften, burn or blow at joints and flanges.

P 103

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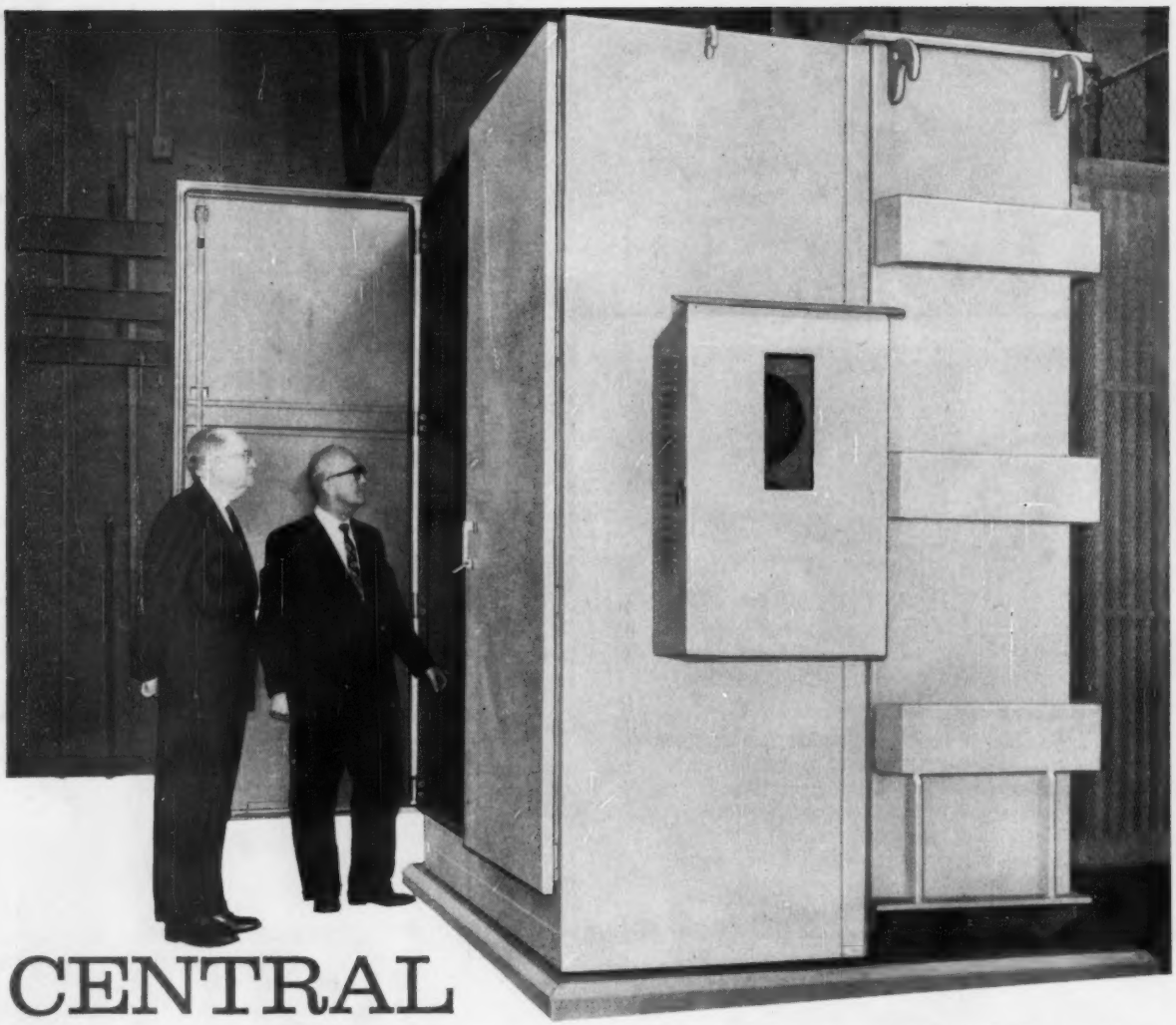

O. B. Ashmore, Senior Engineer, and Lowell Baker, Department Head, Operating Division, for Dallas Power & Light Company, inspect newly installed Pad Mounted Central power transformer.

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This Pad Mounted power transformer, with its neat appearance, compact size, and tamper proof features, solved a space problem for Dallas Power & Light Company. The Central unit shown above is a 1500 kva, 3-phase power transformer rated 13200 delta primary to 240 delta secondary. It is complete with a free standing outdoor enclosure, with two hinged doors enclosing bushings, lightning arresters, high voltage fuses, pot-heads, gauges, valves and current transformers.

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This latest test again demonstrates how you can minimize losses due to corrosion by using ACCO *Aluminized* Steel Core Wire. Another advantage—eliminates danger of electrolytic action.

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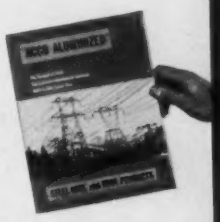
ACCO *Aluminized* wire is commercially pure aluminum bonded to a steel wire. When you specify ACCO *Aluminized*, you get the strength of steel plus the corrosion-resistance of aluminum—produced by a manufacturer with 50 years experience in the development and manufacture of wire for utility service.



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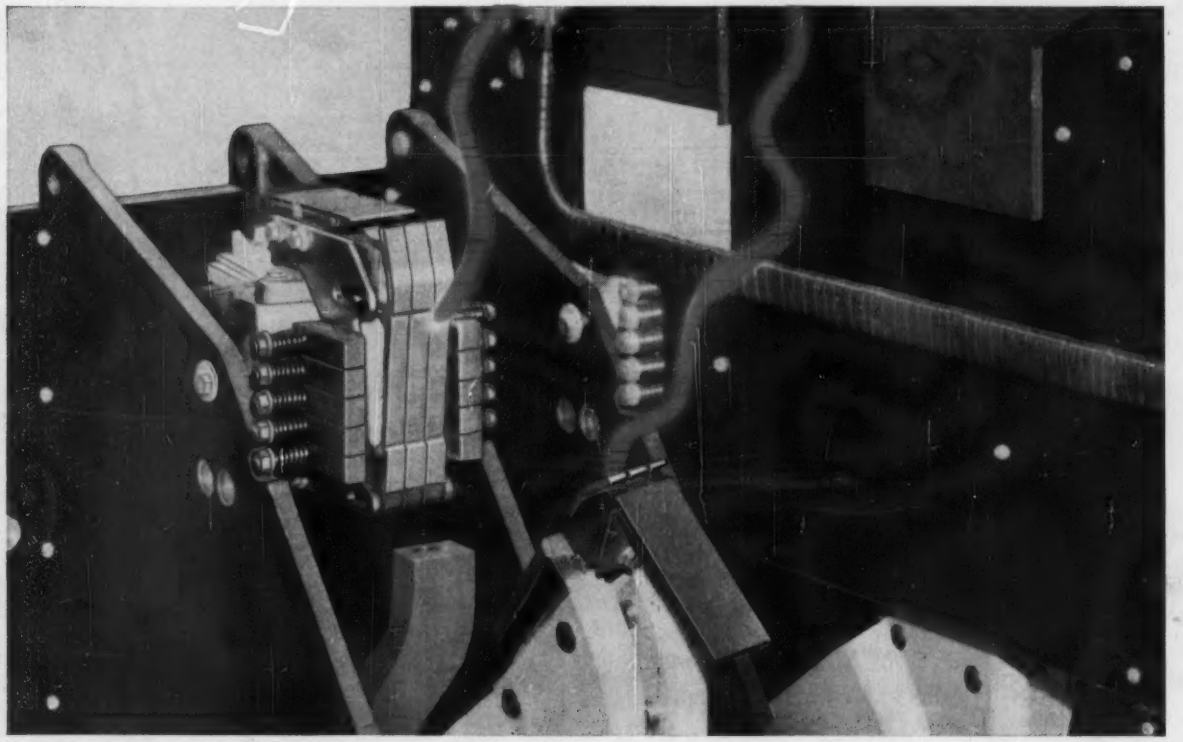

Full protection at 1 million kva

with this 15-kv maximum reliability metal-clad switchgear

New interrupting capability — 1,000,000 kva and below with *Ruptair* magnetic air circuit breaker in A-C 15-kv switchgear, means complete system and personnel safety.

Here are the *Full Protection* facts:

- Maximum reliability assured . . . insulation designed and tested to give utmost dielectric integrity.
- Breaker tested *in the unit* at *full* three-phase rating and beyond.
- Dead-front construction...the only self-locking front protective barrier.
- 3 hinges and 3 knurled screws strongly secure the front panel.
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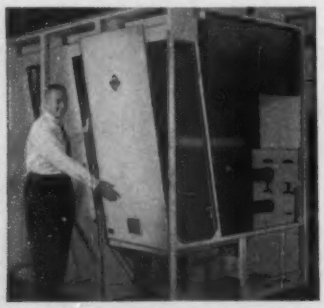
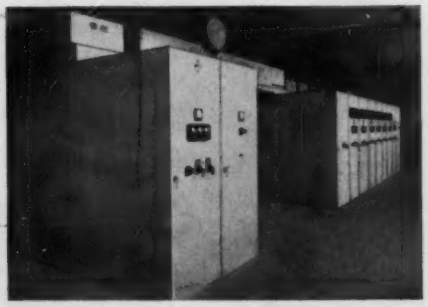
- Enclosed service aisleway provided in the outdoor *Shelter-Clad* switchgear.
- Entire front panel can be used for meters and relays. Both stored energy and solenoid operators are available in a complete line of 5 and 15-kv switchgear. Simply installed, easily maintained, this new 15-kv switchgear now serves utilities, refineries, steel plants, and institutions. For product details, call, wire or write your nearby A-C office. A-1523



Tilted front steel barrier locks with cubicle to protect operator.



15-kv indoor metal-clad switchgear installed in a western utility.

Ruptair and *Shelter-Clad* are Allis-Chalmers trademarks.

Editorial Comment

AUGUST 14, 1961

Welcome to the Combined Cycle

The industry is about to see the first full-scale application of the highly touted gas-turbine steam-turbine combined cycle. Such application is about five years overdue, but it is nonetheless most welcome even now.

One cannot shrug off the bare fact that the sharp pickup of 4% additional efficiency does not come easily or cheaply these days. And this is just what the combined cycle hopes to do (page 72).

Further, this is not the end of the road for this promising path of investigation. Around the corner beckons the full multi-atmosphere pressurization of the furnace, with attendant further efficiency gains and an entirely new set of capital cost bases.

Also, the widening of the application to areas utilizing coal as the basic fuel is another attractive prospect.

Both full pressurization and coal utilization, of course, will require much research and development. At least the latter is already under active exploration.

But meanwhile, the step of building and getting experience with units like Oklahoma Gas & Electric's Horseshoe Lake No. 7 must be undertaken.

Success of this unit will do much to add impetus to the development of the next steps. General Electric Co and OG&E are to be complimented for taking the plunge.

Northwest Power Exposes Paradoxes of Preference

There is a touch of irony that borders on satire in the present moves to write a regional preference clause for the Pacific Northwest.

Conventional preference clauses, found in a number of laws authorizing federal power projects and federal power marketing agencies, generally provide that public bodies and cooperatives be given top priority in the purchase of power produced at federal projects. What the government power men in the Pacific Northwest appear to be trying to do is add a regional preference clause on the top of the conventional preference clauses. They are trying the impossible job of superseding the conventional preference clauses without admitting that these clauses have been modified.

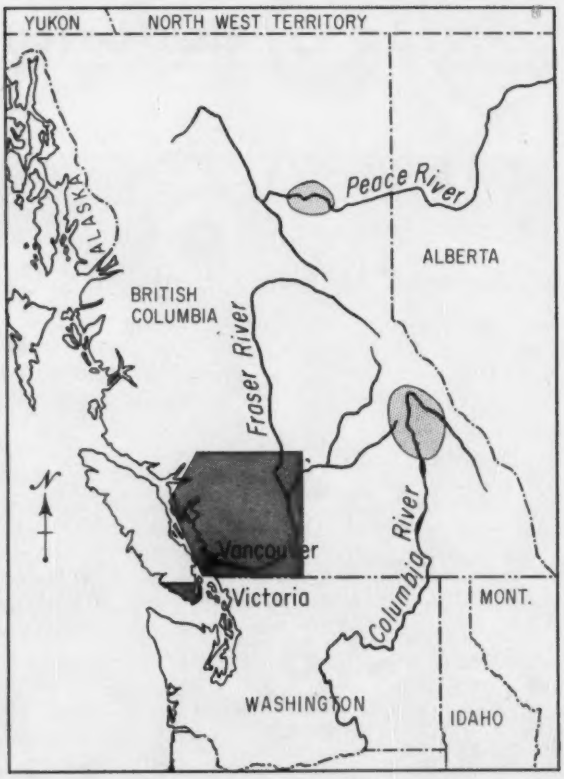
At best, this sort of maneuvering calls for some very tricky gymnastics on the political tightrope. To us, this adds up to a series of paradoxes that exposes the inconsistencies and inequities of the conventional preference clauses.

For instance:

- The Kennedy Administration, which is sworn to uphold the sanctity of the conventional preference clauses, becomes the first administration in 20 years to attempt a radical modification of these clauses.
- The present serious attempts to modify the conventional preference clauses serve to indicate that the ultimate application of these clauses becomes so inane as to scare the original beneficiaries.
- In pleading for funds for Northwest power projects, Congressmen from that area have often told of the widespread benefits such projects bring to every state in the Union. But when it comes to sharing some of the direct benefits of these projects—the tax-free electricity—there is an immediate cry for a favored-area priority clause.

Some federal officials are aware of the danger of exposing the paradoxes to public view. But they are convinced that they must find some sort of protective legislation to preserve the vested interests in the Pacific Northwest if they are to gain the political support required to build extra-high-voltage transmission lines to carry Northwest power to California.

PREMIER W. A. C. BENNETT is known as a "sawdust Caesar" or an "astute statesman" — depending on whether speakers are opponents or allies. His seizure of B. C. Electric Co (dark area at lower left of map) puts him one up on Ottawa over development of Peace (upper right) and Columbia (lower right)



Bennett Seizes BC Electric; Future Hazy for Hydro Projects

The seizure of one of Canada's largest investor-owned utilities by the province of British Columbia has raised important questions and left cloudy the future of electric power development in that province, in Canada, and in the US Pacific Northwest as well.

Premier W.A.C. Bennett announced the planned expropriation of the 1,000-Mw British Columbia Electric Co system before an expectant Legislative Assembly on August 1 and received the Assembly's approval within two days. Thus passed into history one of Canada's most successful utilities, a casualty of Bennett's struggle with his federal government in Ottawa over development of B.C. resources.

The Peace River Power Development Co, a firm organized to develop the industrial potential of the Peace, and the East and West Kootenay Power Cos, two smaller privately-owned utilities, also became property of the province.

Two important river development schemes are central to the controversy:

• Columbia River — the Ottawa-Vancouver fight has prevented ratification of the US-Canada treaty for development of the upper Columbia River. The treaty, signed by Prime Minister Diefenbaker and President Eisenhower in January (EW, Jan. 23, p 50), provides the US 15.5 million acre-ft of storage, for which the US pays Canada $64.4 million. The US would wheel to Canada one-half the additional power made available at existing US Columbia River hydro plants, estimated at 2.5 million kw dependable capacity. Canada would pay the US $1.50 for each kw. Additional Canadian generation would be installed later.

• Peace River—Bennett's pet project is the Peace, which could ultimately generate as much as 3.5 to 6 million kw. He granted a development concession to Swedish financier Axel Wenner-Gren for a huge industrial-metallurgical complex, and Wenner-Gren has put between $5 and $7 million into engineering investigations.

Bennett decided to take over B.C. Electric after the B.C. Energy Board, appointed by him to study the comparative power costs, turned in a report stating that Peace River power would cost, for a basic growth rate, 4.37 mills if developed by a public body but 6.59 mills if developed by private interests. The same report said that Columbia power would cost 4.4 mills if developed by a public agency.

The Energy Board, headed by Dr Gordon Shrum (who now slides over to run BCE as a crown corporation), said that simultaneous development of both sites was feasible, but only if Ottawa allows export of power to the US. The board made no recommendation of which to develop if the federal government prohibits power export, but Bennett sees the Peace as providing the biggest boost to the B.C. economy.

Ottawa doesn't. The federal government is holding a treaty, signed by the US and Canada, and ratified by the US Senate, which calls for development of the Columbia and doesn't involve power export, which some Canadians disapprove of.

Furthermore, Ottawa is suspicious of Bennett's figures. Government studies indicate Columbia power would cost only 3.6 mills, with Peace much more costly. Now, though, Bennett controls the only Canadian markets through which Columbia power can be marketed, and Ottawa is feeling the pinch.

In effect, Bennett has served notice on Ottawa that unless it goes along with his power-export plans he will scuttle the Columbia project.

Bennett maintains that, since Peace power is competitive with Columbia power in Vancouver, it doesn't matter if Columbia is developed or not.

To add weight to Bennett's stand, Dr Shrum has announced from his new post that BCE will apply immediately for a water license to develop the Peace. "We hope to have engineers on the ground within a week," he said.

By taking the Peace project under his wing, Bennett has let the Wenner-Gren interests out of an uncomfortable spot. Reliable estimates of the cost of Peace development now go as high as $1 billion, and the pay-back time recedes farther into the future. And Wenner-Gren retains the industrial and metallurgical concessions.

No plans are in prospect for combining B. C. Electric with the provincially-owned B. C. Power Commission, which serves much of rural British Columbia. Bennett has assigned the Peace to BCE and the Columbia to BCPC.

He maintained that critics would, if the systems were combined, accuse him of using Columbia money to finance the Peace. "If we keep the organizations separate, people will know whether each project is making money. The Peace must stand on its own; so must the Columbia." He added, however, that if Ottawa permanently blocked the Columbia by refusing to grant him an export license, the two would probably be merged.

Bennett said that no export at fire-sale prices is contemplated. He is sure that power can be sold in the US for more than 4 mills, which he feels will be the long-term British Columbia cost.

Bennett still has some problems. To develop the Peace economically, he still has to export power—it can't all be absorbed in British Columbia. And financing the Peace won't be easy after he has already increased the provincial debt from about $600 million to about $1.3 billion by the takeover. But he still can effectively scuttle the Columbia treaty, and Justice Minister Davie Fulton, chief federal spokesman, has grudgingly conceded that Ottawa may consider export of power to the US.

In Washington, US observers think the treaty will be ratified despite Bennett's action. They feel Ottawa will be able to ratify the treaty this year, even though federal and provincial positions are apart at present. And Washington still thinks Columbia development will precede the Peace.

In the Pacific Northwest, US comment was surprisingly sparse. Only Dr Paul Raver, superintendent of Seattle City Light, had any comment on the move. Dr Raver called the takeover beneficial for the entire Pacific Coast, although he thought California would be the most likely beneficiary.

There is no doubt of the legality of Bennett's move. The British North American Act gives provinces control of civil and property rights. Indeed, the provincial government had previously used its inherent powers to bring 29 smaller utilities into the B.C. Power Commission. However, Bennett considered the extraordinary implications of the BCE seizure warranted a special act, and introduced "The Power Development Act of 1961."

Bill 5 of this act empowered the provincial government to convert BCE to a crown corporation through:

1. Purchase of BCE common shares, held by the parent company, B.C. Power Corp, at a cost of $110,985,045.

2. Issuance of $100 million in government 5% parity bonds to replace BCE shares.

3. Assumption of BCE debts estimated at about $399 million.

Under the act, the provincial government promised it would, if necessary, take over the other assets of B.C. Power Corp, which include B.C. Engineering Co and Western Development & Power. B.C. Power Corp may demand that the BCE, its former subsidiary, buy it out at $38 per share for 4.7 million shares at a cost of $178 million, less the $110,985,045. The bill also authorizes BCE as a crown corporation to reimburse the Peace River Development Corp its $5 to $7 million spent on engineering.

Although rumors of the impending takeover have cropped up repeatedly, and Bennett himself warned it was possible (EW, Mar. 20, p 54), most people thought he was bluffing. B.C. Electric officials were given little time to recover from the shock. Along with Dr Shrum, a whole new board of directors has been appointed, although Bennett apparently will keep BCE president Dr H. L. Purdy and his management team.

Ironically, while Bennett was proclaiming BCE a crown corporation, funeral services were being held in Vancouver for A. E. Grauer, chief executive of BCE and B.C. Power Corp. Dr Grauer was regarded as one of the most brilliant Canadians of his generation.

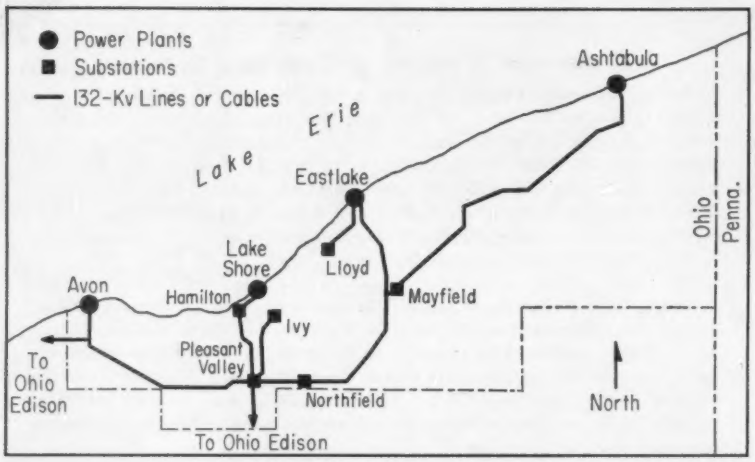
Companies Involved in Canadian Seizure

1. British Columbia Electric Co was a wholly owned subsidiary of the British Columbia Power Corp and was the latter's operating company. British Columbia Electric Co supplies electric and gas service to Vancouver, Victoria, and 83 other municipalities. As of Dec. 31, 1960, it had 340,000 electric customers and 119,000 gas customers, slightly over 1,000 Mw installed capacity, nearly all hydro, and a tie to Bonneville Power Administration near Lynden, Wash. In addition, it runs trolley and bus service in Vancouver, Victoria, and suburbs.

2. Peace River Power Development Co was organized by Swedish industrialist Axel Wenner-Gren to build a $630-million hydro project on the Peace River. Wenner-Gren interests held almost 50% of the corporation's stock. Another British Columbia Power Corp subsidiary, Western Development & Power Corp, held 20%. Remaining 30% was divided among a number of firms. Total of about $7 million has been spent on preliminary engineering investigations.

3. East Kootenay Power Co, Fernie, B.C., was a subsidiary of Power Corp of Canada. It had 27-Mw capacity and served several southern British Columbia towns.

4. West Kootenay Power Co, Trail, B.C., controlled by Consolidated Mining & Smelting, had 41-Mw capacity and also served several southern British Columbia towns.



FAULT OCCURRED between Northfield and Mayfield. Two Eastlake to Northfield circuits tripped at 11:40 am; the third was out for construction; fourth tripped on overload. Ashtabula, separated from main system, continued to carry load east of Mayfield. But Avon, Lake Shore, and OE interconnections could not carry load on western end of system. First, interconnections tripped, then plants developed trouble because of low voltage, at 11:55 am. Hamilton, the downtown Cleveland substation, was quickly put back into service. System was completely back together by 1:20 pm but same type of faults occurred at 1:24 and 3:04 pm causing second outages to some local areas. Everything was practically normal by 3:30 pm.

Flashovers Knock Out 70% of CEI's System

Flashovers from 132-kv conductors to some trees started a cascading action which shut down most of the Cleveland Electric Illuminating Co system on August 4. The sequence of events is described next to diagram above.

Customer outages ran from several minutes to 3 hours. More than 70% of CEI's over 500,000 customers were without power at one time. However, more than 60% of the customers were back in service in one hour and almost all customers were restored in 2½ hours. A few were out longer because feeder load had lost diversity and trouble was encountered putting the feeders back in service.

The company took three steps:

• Ralph Besse, president, took to radio and television to explain the outage to customers and to comment that this was one of the things that shouldn't happen. He promised that CEI would do its best to see this would never happen again.

• Good-sized ads were placed in both Cleveland newspapers to explain further the outage and to apologize for inconveniences.

• Emergency crews cut and trimmed trees in the fault area.

There was no question of capacity. CEI has 1,886 Mw of capacity with some more available through interconnections with Ohio Edison Co. Demand at time of the first tripping was about 1,300 Mw.

There were three major trippings —the main ones starting at 11:40 am, more at 1:20 pm, and the final ones at 3:04 pm. The odd type of fault, sensitive to summer heat and reloading the conductors, caused some difficulty locating it. The second and third trippings were caused by heavily loaded conductors sagging back down into the trees and reinitiating the faults. Reports of a flash between the transmission system and a tree were received from customers.

Most of the customers east of Mayfield substation are served by Ashtabula and were not affected.

Also Hamilton substation, serving downtown Cleveland, served directly from Lake Shore, was on for all but a very few minutes.

Ohio Edison reported the overload on their system threw out some of Elyria and Lorain, Ohio, west of Avon plant, for as long as 2 hours. Heavy loading of the tie caused low voltage and required Lorain to go off the line. Interconnections were out only a few minutes.

Besse said Cleveland Electric has been buying right-of-way for a new emergency tie-in with Ohio Power Co at Canton, Ohio.

Cleveland's Mayor Anthony J. Celebrezze has requested a tie-in between Cleveland's municipal system and CEI. The municipal system was not affected by the CEI outage but had a four-hour outage recently due to an operator error.

CEI SYSTEM consists of parallel 132-kv circuits, usually four, from Avon to Ashtabula, Mayfield to Eastlake and to Lloyd. Three interconnections to Ohio Edison Co—two from Pleasant Valley and one from near Avon—exist. About 900 Mw of efficient generation is at Eastlake and Ashtabula and 650 is at Avon; a new 250-Mw unit is going into Lake Shore. The system extends about 100 miles from Avon to Pennsylvania and is about 17 miles deep.

REA Organization Revised

The Rural Electrification Administration will undergo an extensive revision of organization Aug. 20.

The electric program will be divided among three new divisions: electric distribution, power supply (generation and transmission), and electric standards (engineering).

Creation of the power supply division—announced previously—is the one major new policy change in Clapp's revision order. All generation and transmission loan requests will go directly to this division.

Distribution loans, by contrast, will continue to be processed first in the area offices, then forwarded to the distribution division for review. In this sense, the power supply division will have both line and staff duties, while the distribution division will have only staff duties. The electric standards division generally replaces the previous engineering section.

House Hanford Opposition Grows

But fate of project still undecided. Investor-owned utility industry blasted; reprisals, investigation are threatened

A majority of the House has expressed its opposition to adding $95 million in electric generating equipment to the Hanford NPR and instructed its members on the Senate-House conference to stand firm against including it in the final version of the AEC fiscal 1962 authorization bill.

The Senate earlier had included the controversial generators in its version of the legislation.

The 235-164 House vote was aimed at strengthening lower body opposition, but it by no means wrote an end to the controversy. Under legislative procedure, the Senate can still insist on retaining the provision in the construction bill, forcing the House either to accept a deadlock or recede from its position.

The adamant language of the special instructions was not to agree to Senate amendments restoring the generators to the bill. The wording could not have expressed the House resentment to the public power project more bluntly.

The vote reflected a continuing build-up of House opposition to the project. The latest vote against the generators carried a larger majority than the 176-140 teller vote which eliminated the generators in the House's initial consideration of the AEC bill.

The action also served unmistakable notice that the House would reject any final conference report, if the generators were included at the $95-million figure. Though the decisive vote on the special instructions to the three House members named to the six-man House-Senate conference committee do not have the force of legally binding the conferees, it aptly expresses the will of the House regarding the generators.

Too, the House action fanned the flames of the bitter public vs private power fight long surrounding the development of nuclear power plants.

Rep James Van Zandt (R-Pa.), senior Republican member of the Joint Committee on Atomic Energy, offered the motion to instruct the House conferees not to accept Senate amendments to restore the generators.

At the conclusion of the floor debate, and before Van Zandt could get a vote on his motion, Rep Clarence Cannon (D-Mo.) offered a motion to suspend Van Zandt's instructions to the conferees. The surprise Cannon move lost on an identical 235-164 vote, however.

Pro-Hanford House and Senate Democrats—joined by Secretary of Interior Stewart Udall—had begun to breathe hard on the investor-owned utility industry before the vote came to instruct House conferees.

Capitol lobbying of the utilities to defeat the generators drew the fire of Rep Chet Holifield (D-Calif.), chairman of the Joint Committee on Atomic Energy, and Sen Clinton P. Anderson (D-N.M.), a Joint Committee member and chairman of the Senate Interior Committee. Both accused investor-owned utilities of a "dog in the manger" plan to "bedevil and obstruct" the government's nuclear power reactor program while refusing to go ahead with a developmental program of their own.

Both Anderson and Holifield said the investor-owned power companies would rue the consequences if the "conspiratorial effort to block federal building" of the Hanford generators succeeds.

They promised, in that event: **(1)** An investigation of the private power lobby. **(2)** An end to federal research and development grants to investor-owned utilities for reactor construction. **(3)** No further waiver by the government of nuclear fuel use-charges to private companies operating reactors or buy-back of plutonium from private reactors. **(4)** Cessation of granting long-term (40 year) operating licenses for private reactors. **(5)** No fast tax write-offs. **(6)** Readjustment of rates that utilities are allowed to charge their customers.

Udall urged passage of the NPR generators as a wise use of national resources before a convention of the Western State Land Commissioners at Seattle. He blasted "obstructionism" of the investor-owned power lobby in connection with the Hanford generators.

Holifield likened the utility fight to an Aesop fable: "I say the private utilities are in a preferred status and I want them to restrain their greed. They might read one of Aesop's fables about the dog who made his bed in the hay manger. He would not eat the hay nor would he let the cattle eat it."

Holifield said former AEC Chairman John McCone had offered the steam from Hanford to private industry, and the investor-owned utilities had turned the offer down:

"The Aesop fable is a perfect illustration of the selfish attitude of the privately-owned electric utilities. The former Chairman of the Atomic Energy Commission offered this by-product steam to the private utilities and, for reasons of their own, they turned him down. Like the dog in the manger, they will not use this waste steam and they will not let the people of the Northwest use this great national resource."

Anderson anticipated the investigation of lobbying efforts against the generators.

He spoke of the possibility of an investigation in a speech on the Senate floor. Anderson said, "In carrying on this study I believe we should talk to all leaders in the field, including the Edison Electric Institute. I think we could ask some interesting questions of these men who are supposed to be leaders in their industry and in the field of atomic power.

"We would grant them the right to their own opinions about the Hanford reactor and other projects. But we would want to ask them if they had not gone far beyond any personal opposition to a plant in another region. We might want to ask what corporate efforts they had sponsored to fight the NPR project. We would want to find out whether these men really are for atomic power, or are they the front men for a gigantic conspiracy to slow down new developments."

Preference Laws Asked With Bonneville Tie

The proposed Bonneville Power Authority-California intertie has produced one uniform response from Northwestern Congressmen; that is, there will have to be some sort of protecting legislation—amounting to regional preference—before the intertie can be approved by Congress.

Speculation concerning the possibility of regional preference legislation was spurred after circulation of a proposal by Charles Luce, Bonneville Power Authority administrator, to various Northwest Congressmen (EW, Aug. 7, p 26). The draft proposal would give public bodies in the Northwest first call on power produced in that area by federal projects, but it would also give investor-owned utilities preference over public bodies or cooperatives outside the region.

Some Oregon spokesmen feel that the state of Washington has more to lose from an intertie than Oregon does, because of the greater amount of public power in Washington. Therefore, they feel that Washington Congressmen will push the issue harder.

Washington state leaders, however, feel it's the reverse. Because investor-owned utilities in Oregon would be cut off before Washington's publically-owned utilities, Oregon would be more demanding than Washington.

Facts supporting the Oregon position include the stand taken by Washington Governor Rosellini's Power Resources Advisory Commission, which has adopted a resolution in favor of the protective legislation but has left the door open on specific wording. The two Senators from Washington feel that full protection must be spelled out in a bill.

Conversely, some Oregonians, including Sen Maurine Neuberger, who want the intertie—and its necessary preference legislation—feel that the legislation must be simplified considerably if it is to win approval.

Oregon leaders say that the present bill is complicated and hard to understand but that "something is needed."

Delaware Planners Settle Differences

Major hurdles in the path of a federal-state compact for the development of the water resources of the Delaware River Basin have been overcome, and chances are bright for federal approval of the scheme by early next year.

The Kennedy Administration, represented by Interior Secretary Stewart L. Udall, objected to the plans worked up by representatives of New Jersey, New York, Pennsylvania and Delaware, on grounds that the federal government would be forced to give up control, and at the same time put up money for the project. After a mid-April meeting, proponents of a Delaware River Basin commission said Udall's position would kill the program, in the making for about six years.

However, a compromise is being worked out that now promises to assure the success of the plan much as originally proposed, but including some safeguards to federal authority demanded by Udall.

The agreement, which seems to have the approval of both sides, provides for the government to be a one-fifth partner with the four states, as originally proposed, but gives the government veto power over the comprehensive development plan that the proposed commission would adopt.

Two problems remain, however. First is the reaction of the other federal agencies with an interest in the plan, and second is the government's feeling that preference should be given to public power.

The proposed commission, if it undertook the program proposed by the Army Corps of Engineers in a $2-million study of the river, would build 58 dams over a 50-year period at a cost of $591 million.

Gas Dominates FPC, Says Proxmire

Sen William Proxmire held the Senate floor for two and half days last week to dramatize his charge that natural gas industry domination of the Federal Power Commission has caused inflation in gas prices.

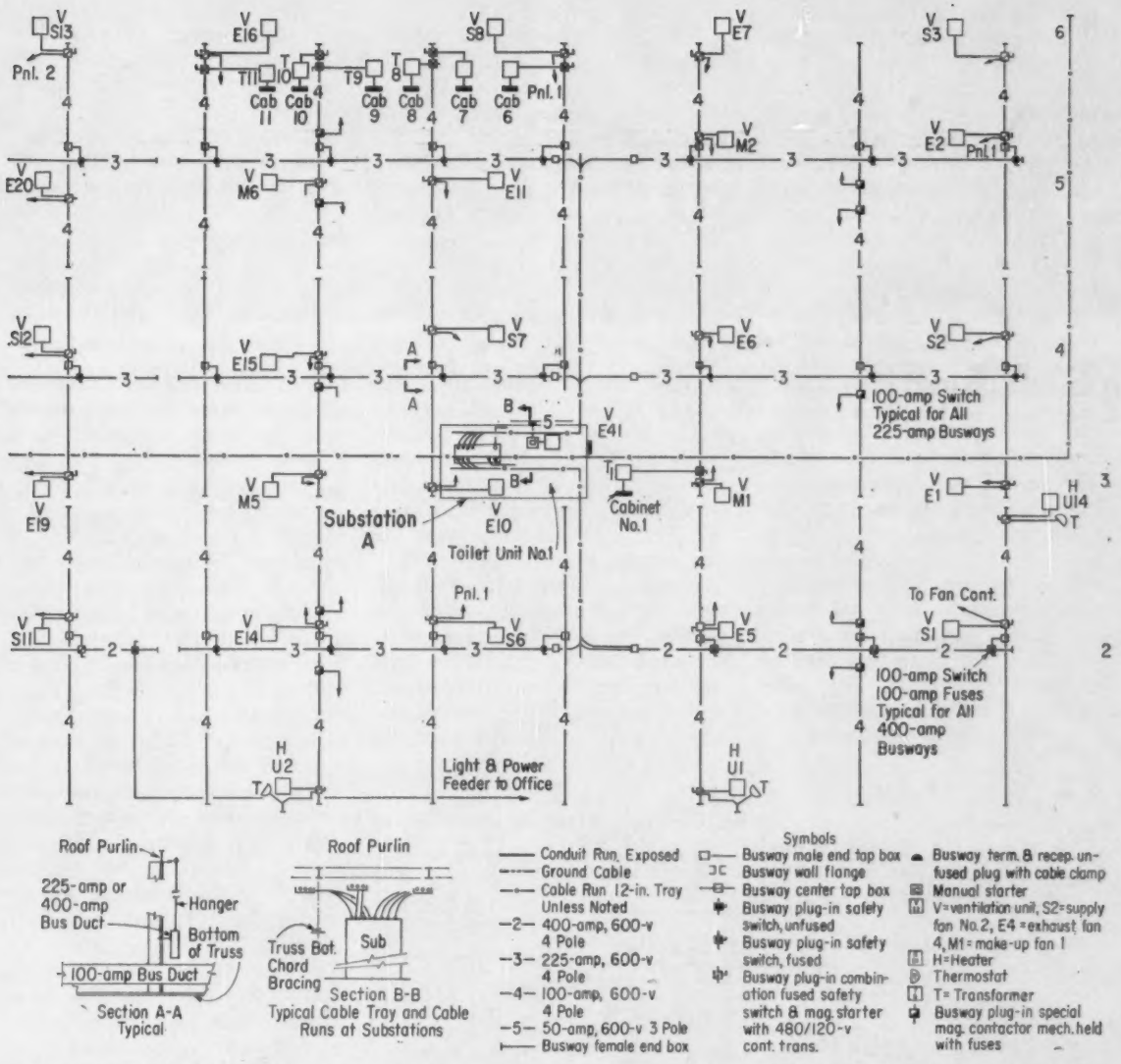
The FPC's role in regulating interstate electric power didn't enter the Wisconsin Democrat's diatribe against Lawrence J. O'Connor, Jr, former Texas oil executive nominated by President Kennedy.

The gist of the attack was that O'Connor, now oil imports administrator in the Interior Department, will serve the gas industry, rather than consumers, as an FPC member.

O'Connor assured the Senate Commerce Committee that he would be objective, and the committee endorsed him without dissent.

From the start of the marathon speech, Proxmire had no hope of defeating O'Connor. His objective was simply to point up the issue. Proxmire kept going through regular sessions on Monday and Tuesday, with interruptions for other business, and throughout Tuesday night.

By midweek, only Sen Wayne Morse (D-Ore.) had joined him in opposing O'Connor with a plea to recommit the nomination to committee.



1 **BASIC BUILDING BLOCKS** in power distribution system include outdoor 4,160-v power switch center, four 1,000-kva power centers (one shown) and 'one-bolt' 3-phase, 4-wire, plug-in, 480-v busways in production areas

277/120-V Busway Serves Plant

Building block concept for lights and power offers initial flexibility and later expansion at low cost

A. A. TSENG, Electrical Engineer, Stone & Webster Engineering Corp, Boston, Mass.

Planning for the electrical facilities of Bausch & Lomb Inc's new plant in Chili, N. Y., for the manufacture of eyeglass frames revolved around these considerations:

1. 277/120-v trolley busway for plant lighting and miscellaneous 120-v power requirements provides the most economical layout with flexibility for quick changes in production facilities needed for new products.

2. A well-coordinated roll-in lighting installation, using trolley busways, remote control and 15,000-lumen fluorescent lamps, has cut initial installation cost by more than 50%.

3. Lighting of high standards and quality for production areas matches the visual comfort provided for office personnel.

4. Use of equipment in a "building block" concept results in flexibility and low-cost future expansion.

These considerations were the solution to the problem posed by the new eyeglass plant. The facility consists of 12 production areas and a large warehouse which also serves as a distribution center. Production and distribution areas are housed in a windowless 510 x 400-

ft building, with 20-ft ceilings and 16-ft truss clearances. Attached to this building are extensive office facilities, a steam plant, locker rooms, loading and shipping docks and a 400-seat cafeteria.

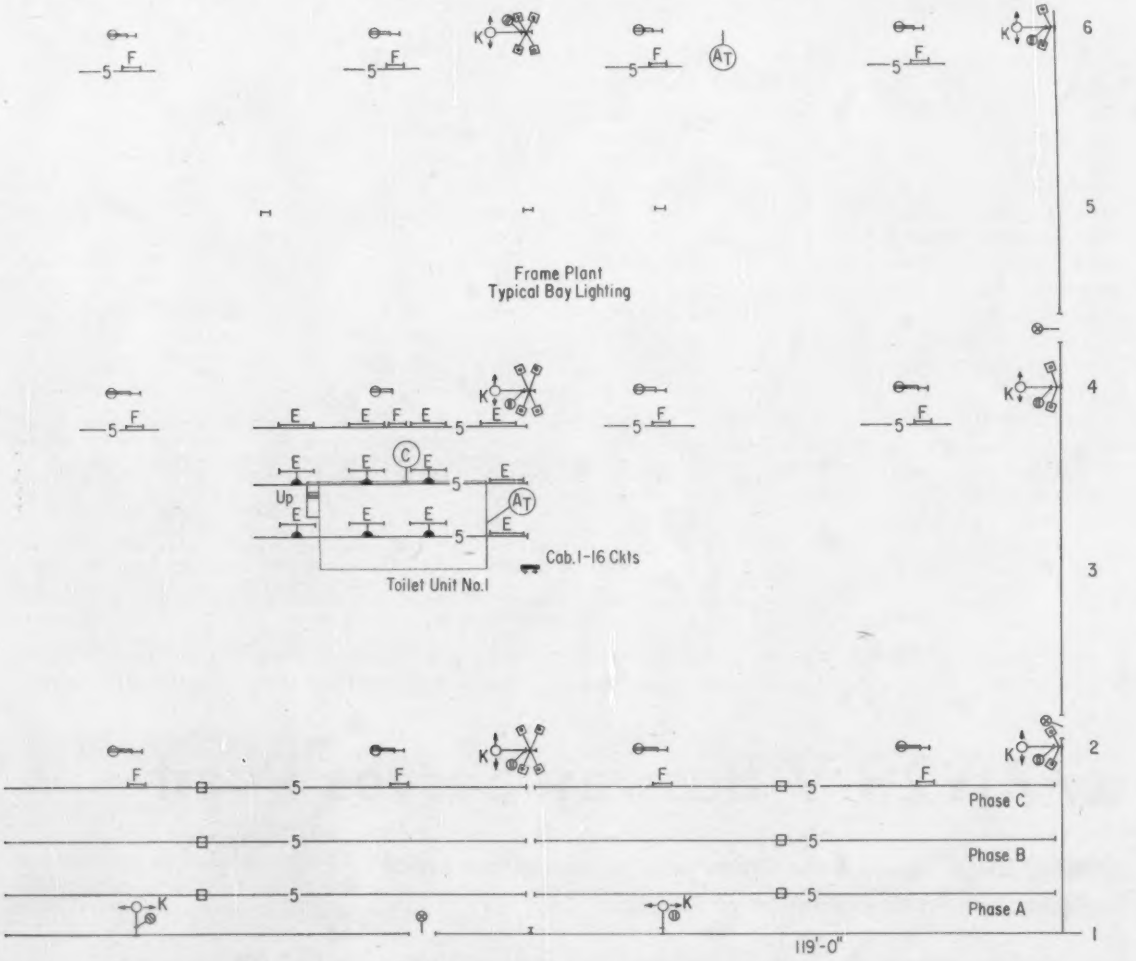
An average lighting intensity of 75 ft-c was established for working areas, with up to 300 ft-c for special needs. There are about 1,000 440-v motors and furnaces and 1,200 110-v electrical devices to be supplied, for a total connected power and lighting load of 5,500 kw.

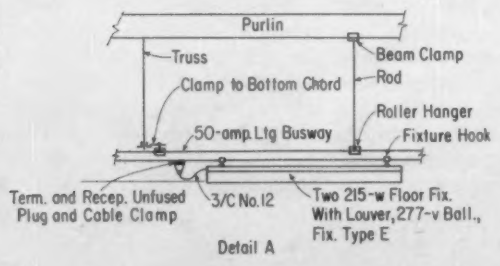
From field surveys and studies covering the new plant's load factor and production schedule, it was decided that by locating each of four 1,000-kva substations above a lavatory, **(1)** the substations would be nearer load centers, **(2)** production areas would be clear, and **(3)** overhead steel supports would be minimized. Also, feeders to the 18,000-ft plug-in bus ducts could be kept overhead with little hindrance.

To meet these facets of the problem the following "basic building blocks" were selected, based on their merits and expected construction savings:

- An outdoor 4,160-v power switching center which connects directly to the adjacent metering and switching cubicles of the local power company. Each cubicle contains a gang-operated, fused, load-break switch.
- Four 1,000-kva industrial power center units. Each unit is an in-

2 GENERAL LIGHTING PLAN shows 15,000-lumen, 277-v, 8-ft fluorescent lamps for average intensity of 75 ft-c. Night lights, 120-v 40-w RS fluorescents, are not switched locally but from area control centers for night security



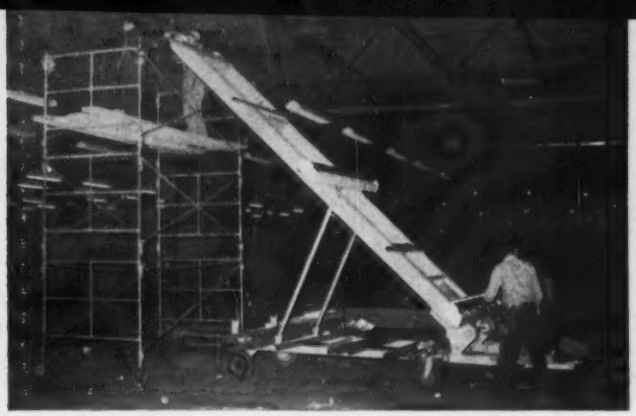


Symbols

- Busway 50 amp. 300v, 3-phase.
- Busway end enclosure.
- Busway term. & recep. unfused plug with cable clamp
- Fluor. fix. mtd. under busway with 227-v plug-in conn., fix. type E.
- Fluor. fix. mtd. under purlin with 227-v plug-in conn., fix. type E.
- Fluor. fix. mtd. under busway with 120-v plug-in conn., for type F, for night ltg.

Symbols

- Fluor. fix., not conn. to busway.
- Emerg. ltg. unit.
- Recep. for emerg. ltg unit.
- Push-button sta. for 277-v ltg. cont.
- Busway center tap box.
- Clock outlet.
- Attendance recorder clock



PUSHBUTTON CONVEYOR HOIST raised luminaires 16 ft to installation point after they were assembled on ground

MECHANICALLY HELD CONTACTOR is plugged into 440/277-v, 3-phase power bus duct for supplying lighting busway

tegrally packaged substation, consisting of a transformer with a 4,160-v primary and seven secondary switches. Kilowatt demand recorders will record various department peak demands for production and scheduling purposes.

• Interlocked, armored, galvanized steel, varnished cambric cables on standard aluminum ladder trays for indoor portions. Only this type of cable bears the Underwriters Laboraotries label; city inspectors were consulted to ensure approval of this type of installation.

• Factory pre-cast concrete manholes and handholes for underground cable installation.

• Plastic conduits, 20-30 ft long, with end couplings for underground installation. Considerable labor and time were saved by using directly buried conduits. Records indicate 2,000 ft of 3-in. and 4-in. conduits can be installed in 24 man-hr.

• New "one-bolt," 3-phase, 4-wire, plug-in, 480-v busways throughout all production areas. Standard lengths and fittings were selected to fit the production layouts. The entire 480-v busway system was assembled 17 ft above ground by a five-man team at 200-240 ft per day.

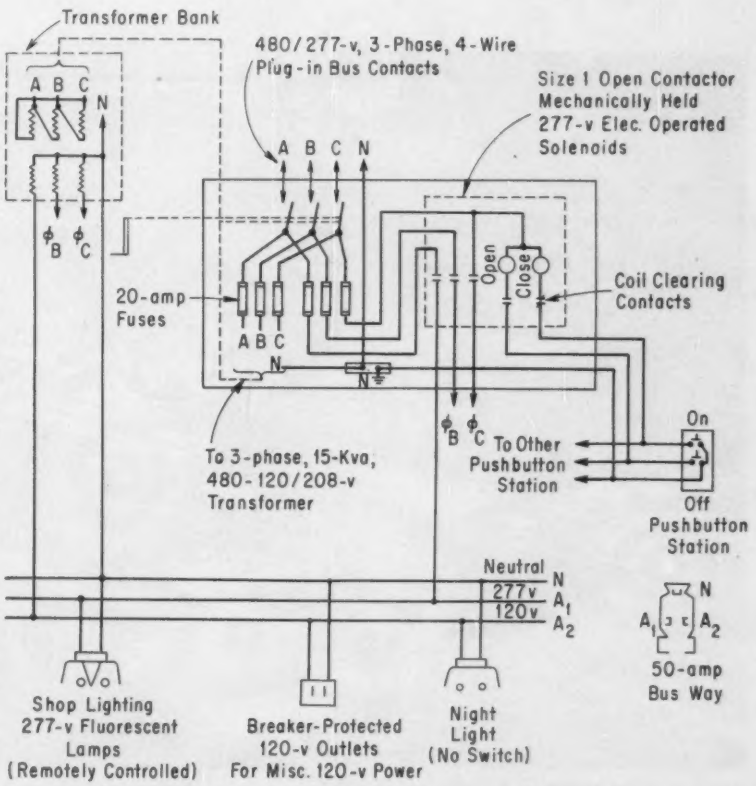
Pre-engineered power equipment packages such as these have many advantages. They are easy to order, with only one specification for the complete power package. Units are completely assembled, tested before delivery, and are easy to install. The equipment is moved into place, the incoming and outgoing lines are connected, and the system is ready for operation.

A typical schematic layout of the plant power distribution system is shown in Fig 1. In general, the plant is illuminated to an average intensity of 75 ft-c by 277-v, 8-ft fluorescent lamps (Fig 2) with intermediate 120-v, 40-w, rapid-start fluorescent night lights, which cannot be switched locally.

The typical control scheme and lighting distribution system throughout the plant is shown in Fig 3. One pushbutton station is provided at each end of the 3-phase, three-row fluorescent fixtures. These push button stations give convenient control of plant lighting to security and supervisory personnel. They provide the momentary current required to energize either the "on" or "off" coils of the mechanically held contactors plugged along the 480-v plug-in buses.

Supplementary lighting is furnished by 40-w fluorescent strip lights over quick-pick racks and standard shelves in the warehouse area. Use of 277-v fluorescent lamps will give about 30 ft-c of light

(*Continued on page* 115)



3 **PLUG-IN DEVICE** provides control of plant lights and 120-v power. Each is a pushbutton station that gives convenient control to the plant personnel

OG&E Combined-Cycle Unit Offers 4%

Gas-turbine steam-turbine unit will have total net output of 200,783 kw at net heat rate of 9,530 Btu per kwhr and expected peaking capability of 237,500 kw. Total cost of project is approximately $23 million

J. B. STOUT, Chief Mechanical Engineer, Oklahoma Gas & Electric Co, Oklahoma City

J. J. WALSH, Partner, Sargent & Lundy, Engineers, Chicago

T. D. McKONE, Gas Turbine Dept, General Electric Co, Schenectady, N. Y.

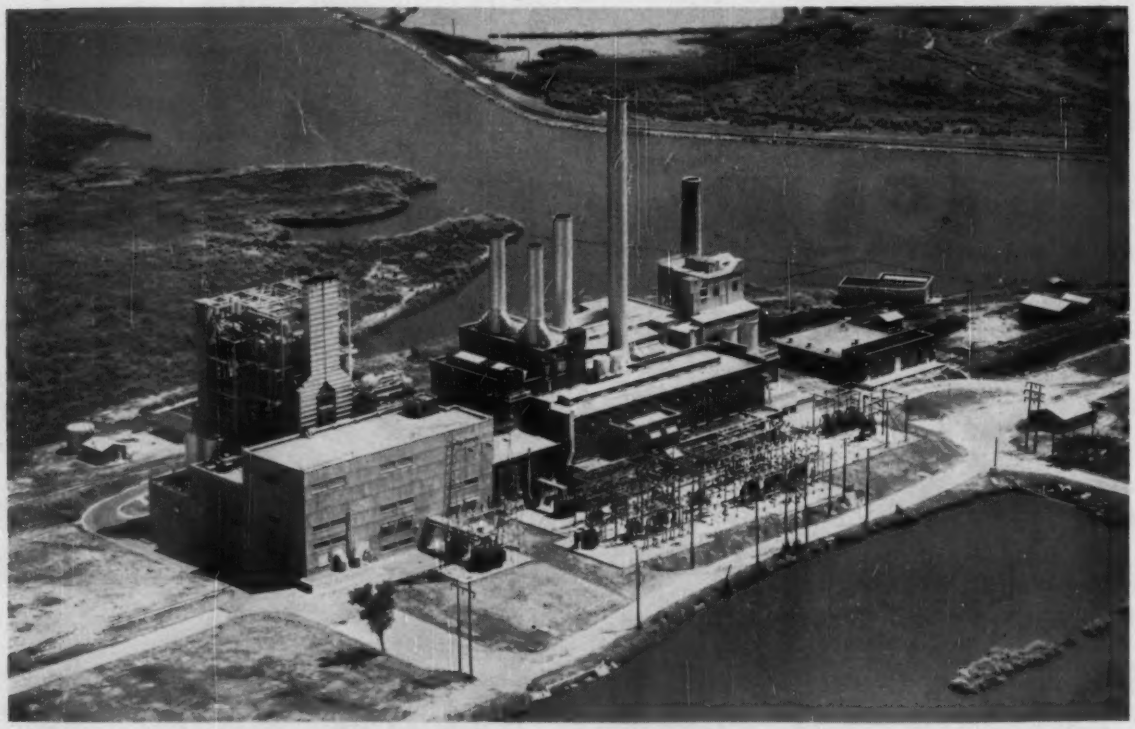
A. G. MELLOR, Electric Utility Engineering Operation, General Electric Co, Schenectady, N. Y.

The world's largest combined-cycle installation today is designed to achieve about a 4% increase in efficiency over a conventional steam-cycle plant using the same steam-turbine installation is now under construction and to do it at an attractive cost. This gas-turbine steam-turbine installation is now under construction as Unit No. 7 at Horseshoe Lake Station of Oklahoma Gas & Electric Co. Total net output at its most efficient point will be 200,783 kw at a net station heat rate of 9,530 Btu per kwhr when burning natural gas. Expected capability for peaking service is 237,500 kw. Scheduled for commercial operation by May 1, 1963 the project will cost approximately $23 million.

Construction of Unit 7 was signalled by an agreement in June, 1960, between OG&E and General Electric Co. Under this agreement GE will provide the complete plant, including all equipment and structures. Detailed engineering is being carried out by Sargent & Lundy, Engineers. Erection of the plant will be done by the construction department of OG&E.

The installation at Horseshoe Lake Station is the natural outgrowth of considerable study over many years of the economics of the combined cycle and the evaluation of the gas turbine for central station operation. Among the comparatively few electric utility installations of gas turbines made to date, OG&E had previously pioneered in another form of the combined gas-turbine steam-turbine cycle.

A small gas turbine installed in 1949 at the company's Belle Isle Station (EW, Aug. 14, 1950, p 88-92) provides exhaust gases to heat feed-water for an existing conventional unit. This installation resulted in a considerable increase in station capability at an improved station heat rate. It was followed by a second, similar unit at Belle Isle in 1952. Although two relatively small combined-cycle units later were installed by other utilities, the new unit for Horseshoe Lake is by far the largest combined-cycle project in the world.



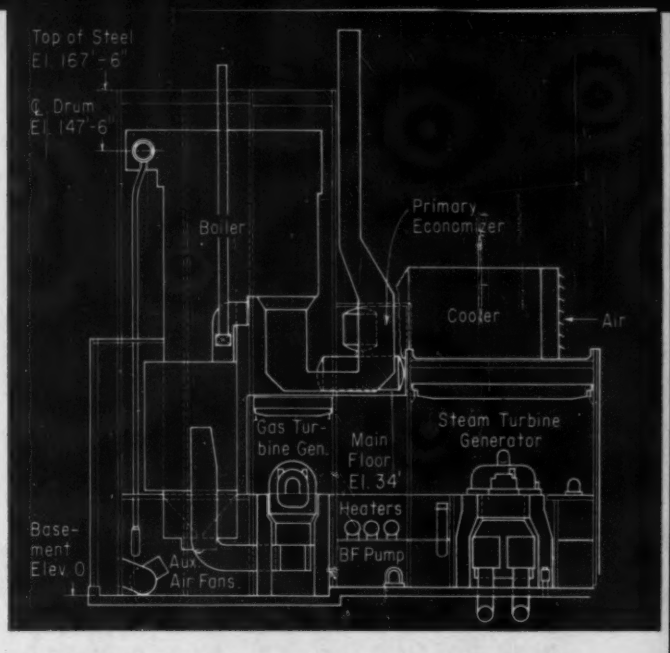
HORSESHOE LAKE STATION is the site of the largest combined-cycle unit ever proposed. This 200-Mw installation, Unit 7, will be installed within the dimensional and space limitations contemplated for a duplicate of Unit 6, a 178-Mw conventional reheat unit of similar steam cycle design. Net station heat rate will be 9,530 Btu per kwhr

Gain in Efficiency

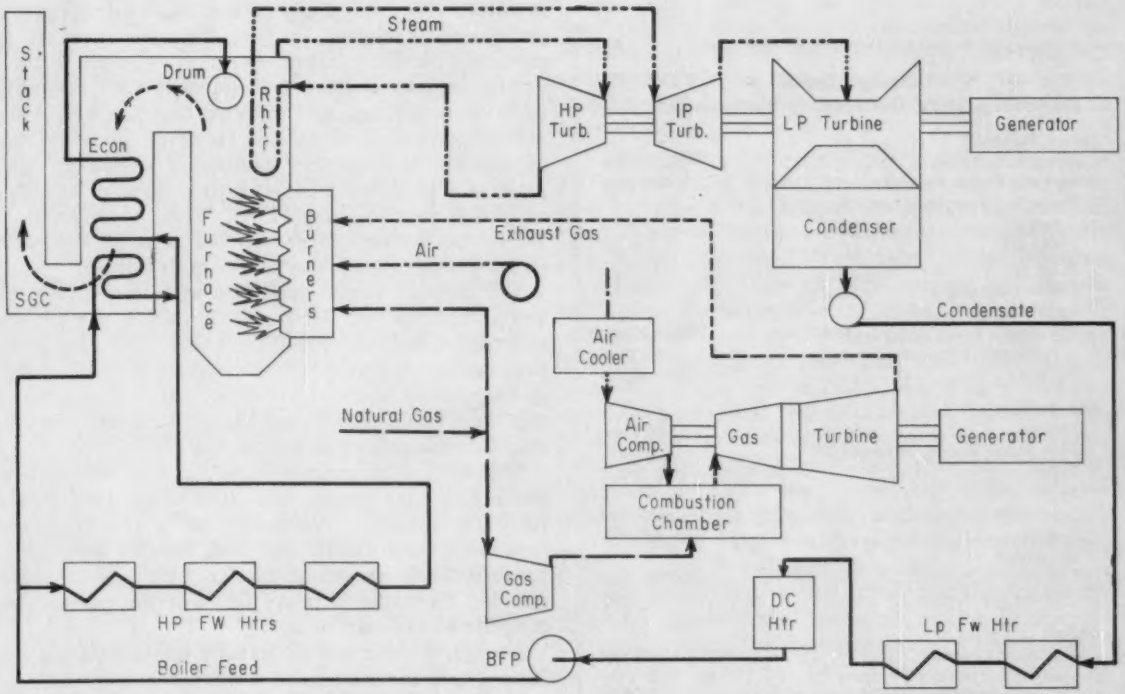
The decision to install the combined-cycle unit was made against this background of OG&E's practices and system conditions. Studies of load and system capability made during 1959 and 1960, jointly coordinated with neighboring systems, indicated a need of between 175 Mw and 240 Mw by OG&E for operation in 1963. Present system total net generating capability is 1,138 Mw, of which 429 Mw are low-pressure units used for peaking service and reserve capability.

Since 1954 large reheat units have been installed because of their lower cost per kw and improved efficiency. Steam conditions have not exceeded 2,000 psig and 1,000F/1,000F because fuel costs will not support the increased investment for higher pressures and temperatures. Studies were made of estimated total annual costs of various methods of increasing capacity, with performance evaluation based on calculated efficiency gains of the combined cycle over the conventional reheat cycle. These studies indicated definite economic advantages of a magnitude which made the combined cycle attractive.

The higher efficiency of the combined cycle may be explained by considering it on a Carnot cycle basis in which the cycle efficiency is dependent upon the temperature difference of the heat input and heat rejection. Because the gas turbine inlet temperature of 1,500F is considerably higher than inlet temperatures



MAJOR NEW COMPONENTS affecting layout of Unit 7 are the gas turbine and primary economizer. Large flows of high-temperature exhaust gas from the gas turbine to the boiler made duct size and flexibility a problem. Primary economizer is the last heat transfer surface in the boiler's convective pass. It substitutes for the air heaters used on conventional boilers to reduce flue gas exit temperature



DUAL-FUEL TWO-SHAFT GAS TURBINE is the largest of its type to be built in this country. One shaft drives the air compressor; the other, the generator. This design allows greater flexibility in adjusting gas turbine exhaust flow to the boiler's needs to meet changing plant loads. Exhaust gases contain enough oxygen to support furnace combustion

of present steam turbines, an efficiency gain can be achieved.

The cycle flow pattern utilizes the hot exhaust gases from the gas turbine as a source of combustion oxygen for the boiler. The exhaust heat so recovered accounts for an increase in combined efficiency. These exhaust gases, at temperatures up to 940F, contain enough oxygen to supply all the combustion oxygen for the boiler at net plant loads up to about 201 Mw.

For combustion and steam temperature control, the exhaust gases are introduced into the boiler at three points: **(a)** through the burner windbox to supply combustion air; **(b)** at the bottom of the furnace to supply gas to maintain steam temperature at reduced boiler loads; and **(c)** near the top of the furnace to supply tempering gas at high loads. Proper distribution of exhaust gases to these points will be obtained by automatic operation of dampers in the gas ducts.

At net unit loads above about 201 Mw, exhaust gases will not provide all of the combustion oxygen needed by the boiler. Oxygen supply, therefore, will be augmented by cold air from either of two supplementary forced draft fans. This air will not be preheated because the primary economizer for feedwater heating drops the stack gas temperature to the desired level. For this reason, the cycle does not include air heaters.

Output of the unit depends upon conditions in both cycles. Thus under normal steam conditions with all feedwater heaters in service, with combustion oxygen for the boiler supplied by the gas turbine, and with an 80F air inlet temperature and 1,500F first-stage nozzle temperature in the gas turbine, the unit will have a net output of 200,783 kw at a net station heat rate of 9,530 Btu per kwhr. Under these conditions, the steam turbine will have a gross output of 185,576 kw; the gas turbine, 23,351 kw. Station auxiliary power will amount to 8,144 kw.

Expected net peaking capability of 237,500 kw will be obtained by operating the steam turbine at 5% overpressure, with the top feedwater heater out of service, and by operating the gas turbine at 1,600F turbine first-stage nozzle temperature. Under these conditions the gas turbine output will be 26,450 kw. The gas turbine will be run at this higher first-stage nozzle temperature only for relatively short periods when peak output is required. Longer periods of operation would obviously result in increased maintenance of the high temperature gas turbine nozzles and blades.

General design of the combined-cycle unit has introduced some unusual features. However, the general arrangement plan follows quite closely that of the 178-Mw Unit 6 conventional reheat unit of similar steam cycle design at Horseshoe Lake. The new unit is being installed within the dimensional and space limitations contemplated for a duplicate of Unit 6, although many general arrangement changes are necessary. The introduction of the gas turbine and the primary economizer are the major new components affecting plant layout.

Other "new" features are associated with the gas turbine exhaust duct layout, the fuel situation, the control features, and the unusual boiler modifications required by the combined cycle.

The handling of large gas flows at elevated temperatures in the exhaust ducts, including dampering and isolation arrangements, required solution of difficult problems in flexibility because of the large duct sizes involved. The complexity of the duct and dampering arrangements resulted, in part, from the necessity of providing for independent operation of either turbine.

The original concept contemplated only combined cycle operation, and it is intended that this will be the normal method of operation. However, the plant will incorporate new features and larger equipment than previously used, and new generation must be available on the system by May, 1963. These considerations led to the decision to provide for separate operation of the gas turbine and the boiler-steam turbine.

Full-capacity forced-draft fans with necessary ducts and dampering will be installed, plus a gas turbine exhaust bypass duct around the boiler. This emergency exhaust duct layout takes full advantage of the boiler gas tempering ducts to minimize costs. It is planned that these facilities will rarely be used but will be available for emergencies as well as test runs.

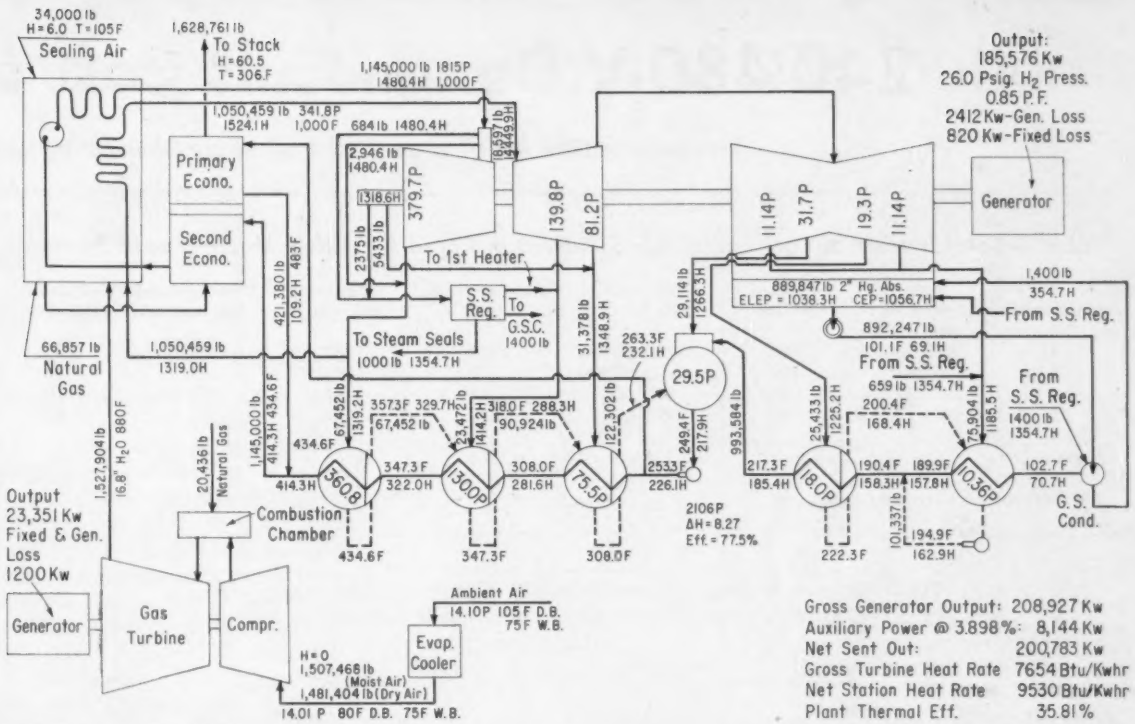
The natural gas transmission facilities now serving Horseshoe Lake Station will be adequate for the new fuel requirements. Normally, the gas turbine and boiler will burn natural gas, with standby fuels to be used should the gas line supply fail completely. Standby fuel for the boiler is heavy oil. For the gas turbine, distillate fuel oil will be used.

The gas turbine and its standby fuel equipment will be designed for semi-automatic transfer from fuel gas to distillate fuel oil. Both fuels may be burned simultaneously, during the transition, or operation may be continued on both fuels if an impending emergency so dictates.

One of the most unusual features of the boiler is the

Design Data
Horseshoe Lake Generating Station—Unit 7

Steam Turbine	
Nameplate Rating	188,500 kw
Throttle Steam Pressure	1,800 psig
Throttle Steam Temperature:	
Initial	1,000F
Reheat	1,000F
Type	TCDF
Exhaust Blading	26 in.
Generator:	
Rating	235,000 kva
Hydrogen Pressure	30 psig
Type	Conductor Cooled
Gas Turbine	
Rating	25,000 kw
First Stage Nozzle Temperature	1,500F
Type	Simple Cycle—Two Shaft
Fuel:	
Primary	Natural Gas
Backup	Distillate Oil
Generator:	
Rating	32,000 kva
Hydrogen Pressure	30 psig
Boiler	
Maximum Capacity	1,350,000 lb/hr
Superheater Outlet Pressure	1,900 psig
Superheater Outlet Temperature	1,005F
Fuels:	
Primary	Natural Gas
Backup	Heavy Fuel Oil
Future	Pulverized Coal



Gross Generator Output:	208,927 Kw
Auxiliary Power @ 3.898%:	8,144 Kw
Net Sent Out:	200,783 Kw
Gross Turbine Heat Rate	7654 Btu/Kwhr
Net Station Heat Rate	9530 Btu/Kwhr
Plant Thermal Eff.	35.81%

PERFORMANCE OF COMBINED CYCLE is improved about 0.5% with a parallel primary economizer arrangement. Feedwater from boiler feed pumps divides into two paths, one through the primary economizer, the other through three stages of high-pressure feedwater heaters. Flows are combined before feedwater enters secondary economizer

substitution of a primary economizer for the air heaters. The primary economizer is the last heat transfer surface in the convective pass of the boiler. It takes the place of air heating equipment as utilized on conventional boilers to recover heat from the flue gas. Exit gas temperature is dropped to about 300F by the primary economizer, thus ensuring good boiler efficiency.

The original heat cycle incorporated a series primary economizer whereby all feedwater from the boiler feed pumps would flow through the primary economizer and then through two stages of feedwater heating before flowing to the secondary economizer. Further studies showed that a gain in station heat rate of about 0.5% could be achieved by changing the cycle to a parallel primary economizer arrangement.

In the cycle adopted, feedwater from the boiler feed pumps divides into two parallel circuits between the primary economizer and three stages of high-pressure feedwater heating. Flows through these paths then are combined before entering the secondary economizer. At high loads, about 40% of the feedwater passes through the primary economizer and 60% through the feedwater heaters.

This arrangement requires considerably more surface in the primary economizer and this extra cost must be balanced against the efficiency gain that can be achieved. To limit their sizes to reasonable limits, both the primary and secondary economizers will be of the extended surface type, i.e., studded tubes rather than the normal smooth tube construction.

The gas turbine in this combined-cycle plant is a dual-fuel, two-shaft design. It is the largest gas turbine-generator unit of this type to be built in this country. The combination of one turbine driving the air compressor and the other driving the generator was selected because of the greater flexibility obtainable in adjusting gas turbine exhaust flow to the boiler to meet changing plant loads.

Because gas turbine capability is very sensitive to air temperature at the compressor inlet, an evaporative-type cooler will be installed to reduce the inlet air temperature to 80F under ambient air temperatures of 105F dry bulb and 75F wet bulb. A high efficiency oil-bath-type filter and an inlet silencer will also be installed on the gas turbine air intake.

The decision to install the additional capacity at Horseshoe Lake Station was aided by computer system load studies. The center of the new system load and the most economical transmission cost pointed to the general area of Oklahoma City as a site for added capacity. Horseshoe Lake Station, about 20 miles east of Oklahoma City, most nearly met these requirements. It also had the added advantage of an available operating force which would require only one additional position to operate another large unit.

Furthermore, the existing cooling lake can be expanded to provide the additional cooling surface required for the added heat dissipation. Expansion of the lake for additional cooling also entered into the economic determination that the combined cycle is more attractive than a straight steam cycle. The gas turbine portion of the combined cycle reduces the heat rejected for the same total power output, thus reducing investment required in the lake expansion.

240/480-V Design Cuts Cost of

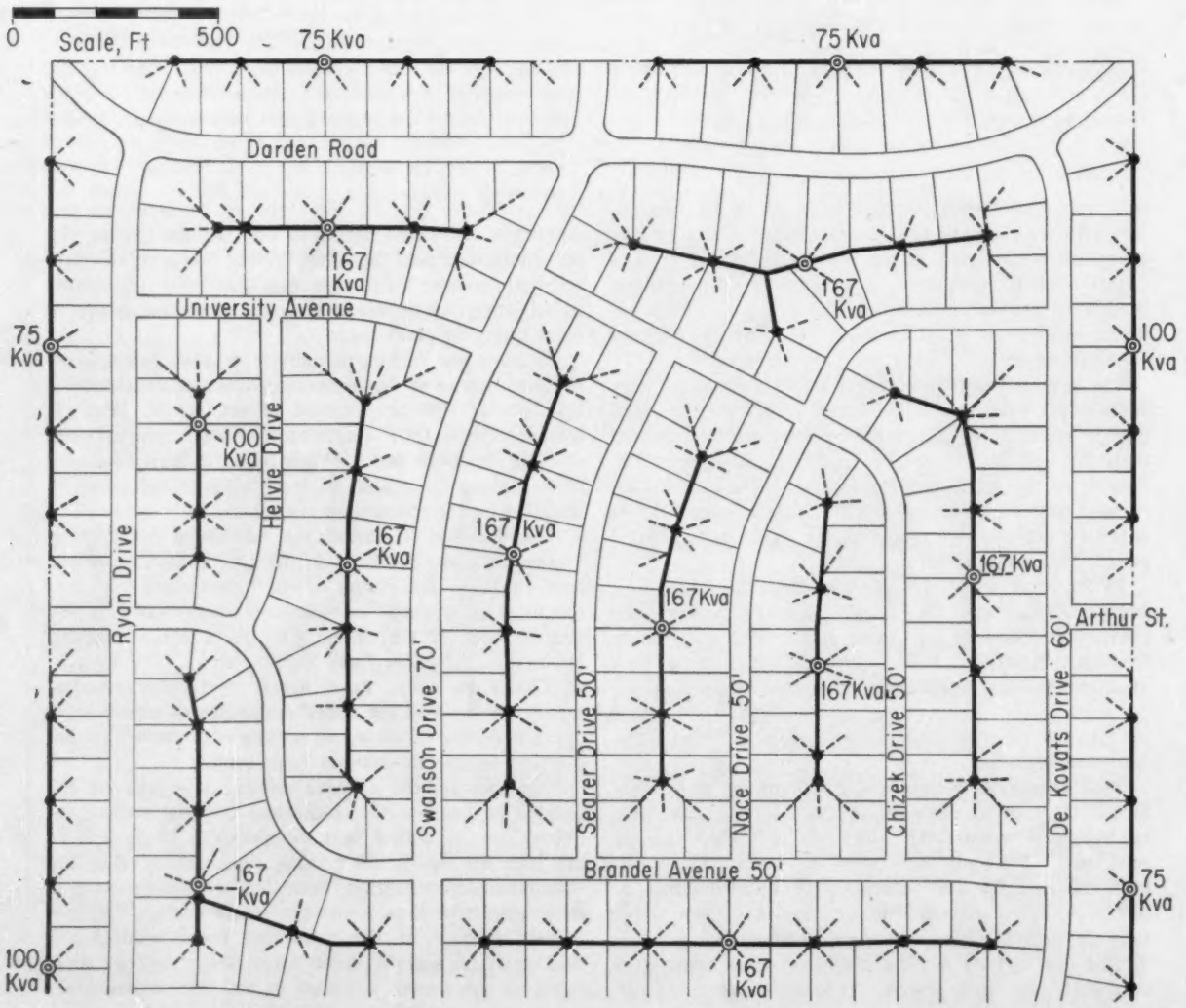
Investment differential is partially offset by savings in losses

Table I—Total Investment per Lot Within Subdivision Pared by 480-V Underground System

Subdivision	No. of Lots	Frontage of Lots	Overhead 120/240 V	Underground 120/240 V	Ratio UG/OH	Underground 240/480 V*	Ratio UG/OH
A	333	100′	$300.00	$502	1.67	$452.00	1.5
B	74	100′	400.00	720	1.8	633.00	1.58
C	149	90′	303.00	568	1.88	522.00	1.72
D	75	60′	295.00	580	1.97	535.00	1.81
Average			324.50	574	1.77	528.00	1.63

* Includes cost of 3-kva auto transformer

SUBDIVISION A (below) illustrates 240/480-v underground distribution which, according to Table I, can give cost approaching that of conventional overhead



Underground Residential Distribution

and repetitive tree trimming for conventional overhead system

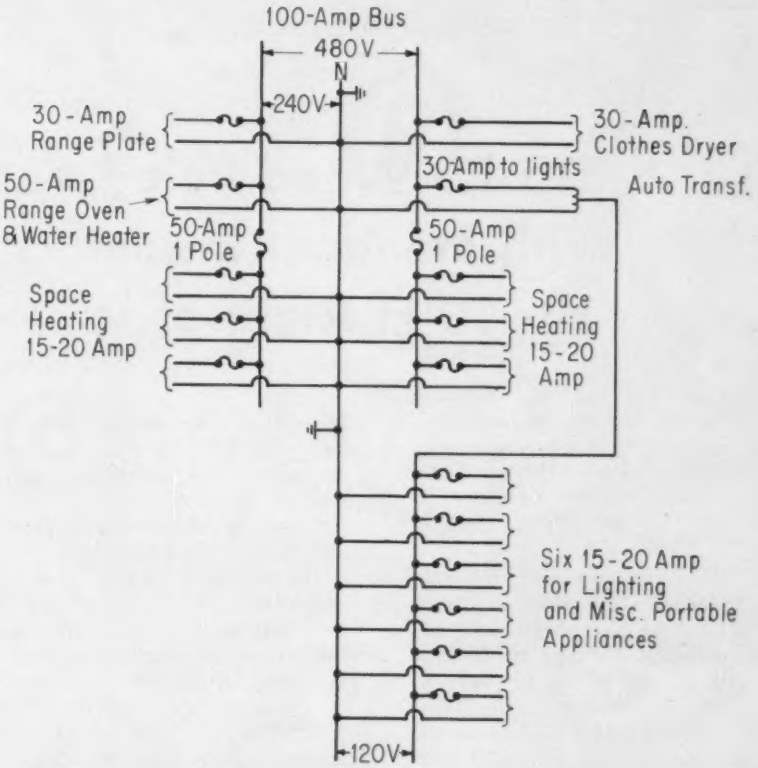
WAYNE H. JOHNSON, Head, Distribution Engineering Section, AEP Service Corp, New Yo·k

Underground residential distribution at 240/480 v offers utilities a substantial savings in cost, compared with a 120/240-v cable system. When credited for savings in losses and the tree trimming it eliminates, the higher-voltage system promises underground service at an annual cost less than 10% above that of a conventional overhead system. Accordingly the higher-voltage system must be considered for every new residential area for which the subdivider requests underground distribution.

Cost estimates completed recently for four different real estate developments show 240/480-v underground distribution investments of $452 to $633 per house, including autotransformers for 120-v devices, compared with $295 to $400 per house for conventional overhead systems. The 240/480-v system costs 8 to 14% less than comparable 120/240-v underground.

Savings for the higher-voltage underground system stem from the reach of its secondary cables within limits set by required service voltage. This feature permits more customers to be served from each transformer location than can be served economically by conventional-voltage secondaries. Thus the higher-voltage system can be designed to use a considerably smaller number of larger transformers. Furthermore, as service current is cut in half by using the higher voltage, service cables can be smaller and less costly than those required at conventional voltage.

Services are included in all cost estimates. These services would terminate at entrance equipment designed to supply space heating and all major appliances at 240-v line-to-ground and an autotransformer of about 3 kva to supply 120 v for conventional lighting and portable appliances. An enterprising manufacturer must be found to produce an economical approved entrance facility for such installations.



ENTRANCE EQUIPMENT for 240/480-v service should provide connections for 240-v-to-ground built-in devices and 120-v section for lighting and appliances

Table II—Annual Cost Comparison Shows 240/480-V Underground Approaching Cost of 120/240-V Overhead

	240/480-V Underground	120/240-V Underground	120/240-V Overhead
Plant with Subdivision A: Investment per Lot	$452.	$502.	$300.
Annual charges	$77.00	$85.30	$52.50
Losses within subdivision	9.00*	9.70	11.50
Supply plant including generation	$248.00	$248.00	$249.00
Total Annual Cost	$334.00	$343.00	$313.00

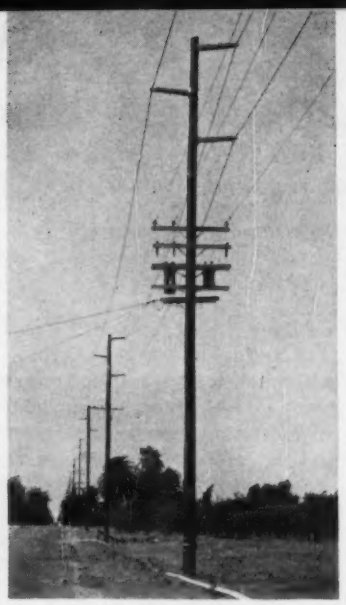
* Includes losses in autotransformer

Distribution costs for the four areas are summarized in Table I. In this summary, Subdivision A, because of its size and the relatively small amount of rear-property distribution serving a single row of lots, requires the lowest investment per home for underground. It is also very near the lowest for conventional overhead. Thus it appears to provide the best comparison for ex-

(*Continued on page* 114)

ELECTRIC UTILITY METHODS

CONSTRUCTION



115-Kv Wood-Pole Line With Standout Insulators Fits 10-Ft Right-of-Way

J. M. GRIGSBY, Electrical Engineer, and **A. A. DIXON**, Superintendent, Overhead Distribution and Transmission, Modesto Irrigation District, Modesto, Calif.

A 115-kv wood-pole line with horizontal line posts is being erected by the Modesto Irrigation District to overcome the high cost of right-of-way for conventional steel tower construction.

The two 115-kv circuits along the 10-mile route, divided into two circuits over different rights-of-way, each as narrow as 10 ft, will provide increased reliability. A 25% saving for labor and material is anticipated, not counting the fact that 12-kv distribution underbuild is also possible on the wood poles.

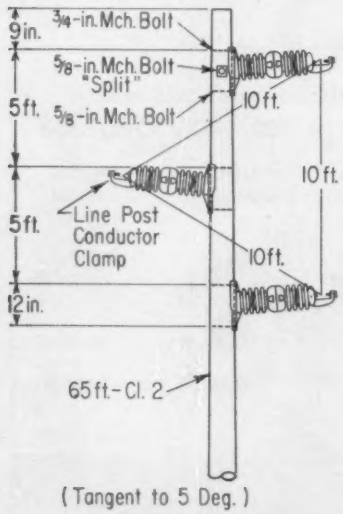
Installation of the line through urban and highly developed farming areas made it imperative to consider an alternative to tower line construction. Public objection to tower lines is pretty general, while pole lines are usually accepted as a necessity today. Public acceptance of the 115-kv pole line has been very good—in fact, not a single complaint has been received.

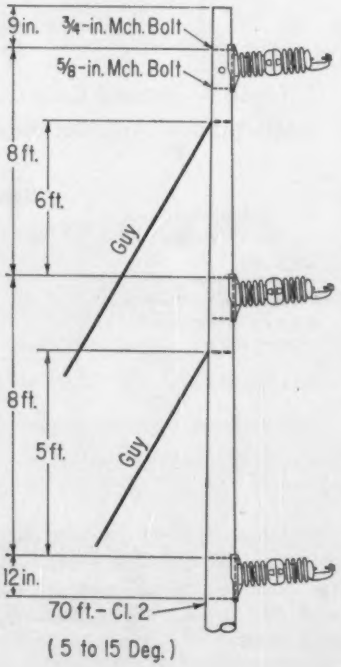
The 65-ft tangent poles of fully-treated Douglas Fir, Class II, are spaced 20/mile. Angle and dead-end poles are 70 ft high. Post-type insulators are mounted two on one side and one on the other side at 5-ft center lines. This insulator, with high-strength porcelain and 2,800-lb cantilever capacity, is 47 in. long, which results in 10-ft separation along the line and 8-ft separation at dead-ends.

The conductor is 954 MCM, 37-strand, AA "Magnolia" pulled to 2,000-lb tension at 25F—no wind. Preformed line guards are used on the conductor in the insulator clamp; jumper compression fittings and splices are used.

The great majority of the poles were set with the insulators, stringing blocks and ½-in. fall lines installed. The fall lines were tied together to make a continuous line which was used to pull the 1⅛-in. Manila bull line through the stringing blocks. The bull line was attached to the conductor by means of cable grips and swivel and was then pulled under tension.

Stringing equipment consisted of an hydraulic tensioner and reel stand mounted on a two-wheel trailer and a puller. The puller is simply a large metal reel, containing 5,000 ft of 1⅛-in. Manila bull line powered by a winch drive and installed on a flatbed truck.





TWO CONFIGURATIONS were used to crowd 115-kv lines into right-of-way where suspension construction would never be used. Original sketches were made available by the courtesy of Lapp Insulator Co

LOWER
TOTAL
OWNING
COST

GENERAL ELECTRIC ANNOUNCES . . .

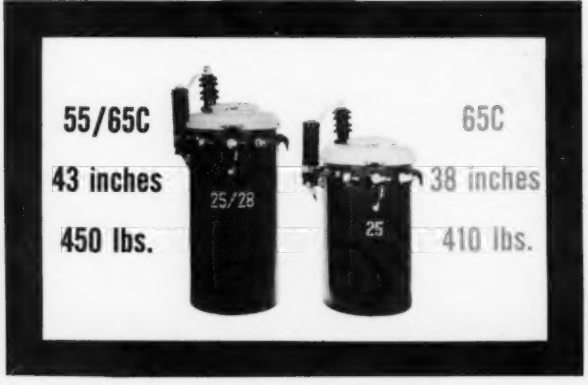
PERMALEX® 65 DISTRIBUTION TRANSFORMER

Switch to 65C operation enables utilities to take full advantage of General Electric's Permalex transformer insulation system . . . *with no change in operating practice*

GENERAL ELECTRIC

Forty pounds lighter and five inches shorter: this is how the 25-kva, 7200-volt PERMALEX 65 distribution transformer compares with its 55/65C predecessor. Similar reductions in size and weight are made on all PERMALEX 65 transformer ratings. This new, smaller, and lighter transformer offers substantial savings to electric utilities on "joint use" poles, as well as in installation, changeout, and inventory costs.

SMALLER SIZE, LIGHTER WEIGHT

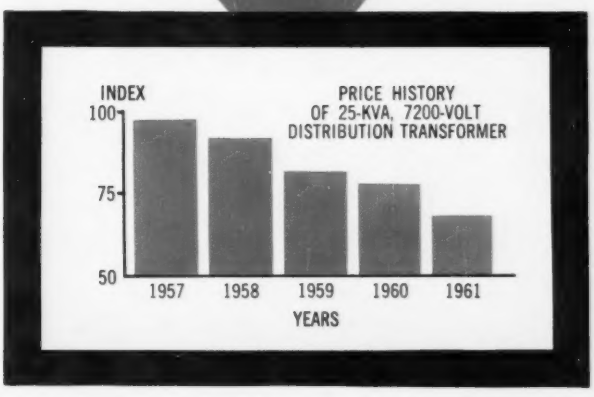


Redesign of General Electric's Permalex transformer into the single-rated PERMALEX 65 design also brings new reductions in utility distribution-system operating cost. Copper and iron losses have been lowered and, through lower impedance, regulation is improved. These improvements will help utilities meet increasing loads and their requirements for better voltage and service continuity—with greater economy and reliability.

LOWER OPERATING COSTS

With the introduction of the PERMALEX 65 distribution transformer, General Electric continues its program of passing manufacturing cost savings on to utilities in the form of lower purchase price. Chart of popular 25-kva, 7200-volt, no tap rating (below) illustrates how G.E.'s initiative in sharing cost savings has lowered utility capital expenditure on distribution transformers since 1957. Price reductions have been made on all PERMALEX 65 transformers in preferred-kva ratings.

LOWER PURCHASE PRICE



How General Electric insulation research paves the way to lower transformer total owning cost

Cyanoethylated kraft insulation, heart of G.E.'s transformer insulation system, was developed by skilled chemists in General Electric's distribution transformer insulation laboratory in Pittsfield, Mass. The new PERMALEX 65 design makes *full* use of G.E.'s thermally superior insulation system, permitting new reductions in size, weight, and purchase price of distribution transformers.

Lower total owning cost for distribution transformers is a prime General Electric objective. Historically, the stage was set for the 65C-rated transformer in May, 1959, when General Electric announced its high-temperature Permalex transformer insulation system. Then, in 1960, G.E. introduced its "dual-kva" rating. A second kva rating was assigned to Permalex transformers, based on 65C average winding rise. This served as an intermediate step to the development of today's single-rated 65C unit.

General Electric's new PERMALEX 65 transformers cost less to purchase, to install, to operate, and to change out. *This* is Lower Total Owning Cost. Your G-E sales engineer has the complete story. Section 482-25, General Electric Company, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Taut Band Instrument Aids Metering Task

B. H. DORMAN, System Project Engineering Dept, Niagara Mohawk Power Corp, Buffalo, N. Y.
E. V. ELLETT, District Engineering Dept, Westinghouse Electric Corp, Buffalo, N. Y.

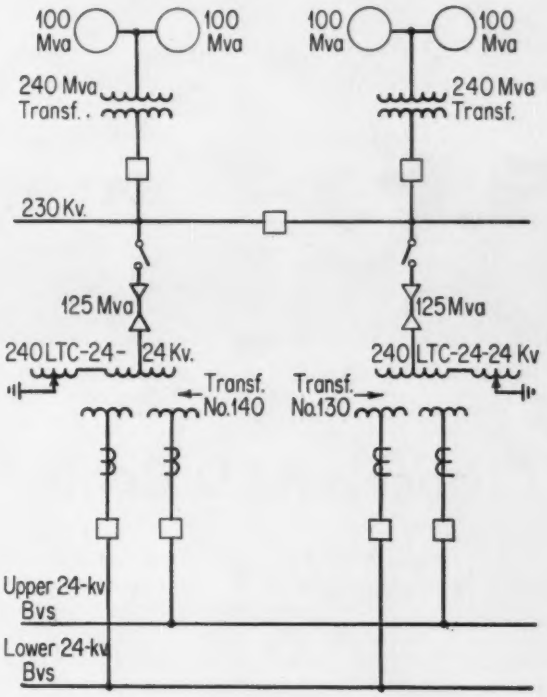
A new switchboard instrument that features taut-band construction has helped solve a difficult metering problem for Niagara Mohawk Power Corp. The instrument operates without a pivot or bearing assembly and requires only 13 microwatts for full-scale deflection. It is easily calibrated, rugged and is available with 50-μamp full-scale deflection and an overload capacity of 150 times its rating.

The problem arose in metering the dual low-voltage windings of two 125-Mva 240-24-24-kv, 3-phase transformers at Niagara Mohawk's Huntley Station. One 24-kv winding of each transformer is connected to the upper bus and one winding to the lower bus. Because supervision of the transformer loading is from two separated control rooms, it was desired to indicate on megawatt and megavar instruments at each location real and reactive power flow from the 240-kv to each of the 24-kv windings.

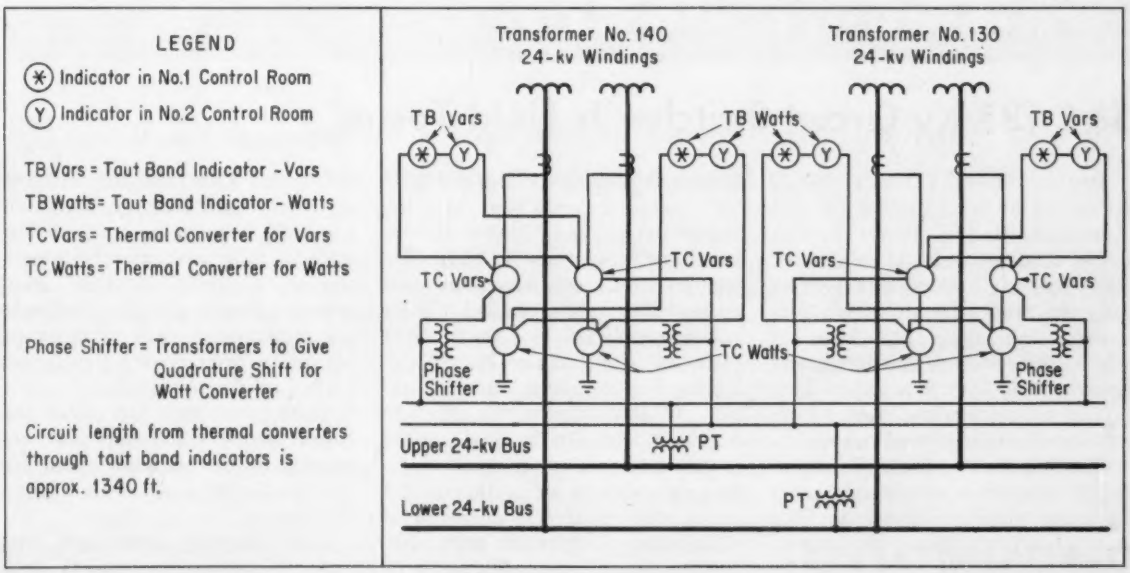
Two thermal watt converters, one each for real and reactive power, were installed on each 24-kv winding. The dc output of each pair of real and reactive power units was to be connected in series and the combined output of each pair indicated on properly calibrated instruments, one in each control room for each pair of elements. The control rooms are separated by a cable distance of 670 ft, making a total circuit length of 1,340 ft of No. 12 copper wire between each pair of instruments (2.3 ohms ±).

Given these requirements, it was decided that an

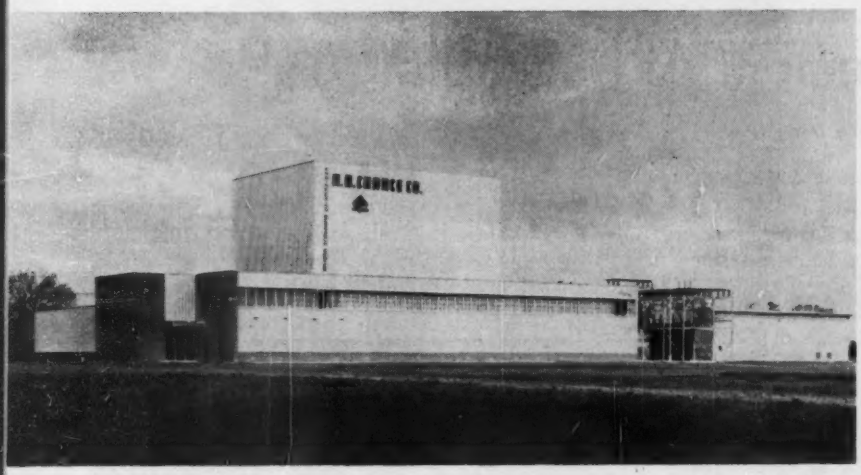
(*Continued on page* 118)



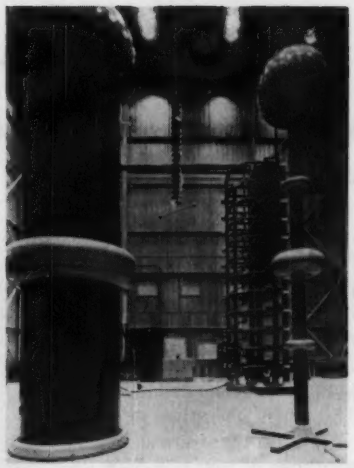
ONE-LINE DIAGRAM of Huntley Station (above) shows points where 24-kv transformer windings are metered. Instrument connections (below) provide duplicate real and reactive meters in widely separated control rooms


LEGEND
Indicator in No.1 Control Room
Indicator in No.2 Control Room
TB Vars = Taut Band Indicator - Vars
TB Watts = Taut Band Indicator - Watts
TC Vars = Thermal Converter for Vars
TC Watts = Thermal Converter for Watts
Phase Shifter = Transformers to Give Quadrature Shift for Watt Converter
Circuit length from thermal converters through taut band indicators is approx. 1340 ft.
Transformer No. 140 24-kv Windings
Transformer No. 130 24-kv Windings
TB Vars
TB Watts
TB Vars
TC Vars
TC Vars
TC Vars
TC Vars
TC Watts
Phase Shifter
Phase Shifter
Upper 24-kv Bus
PT
Lower 24-kv Bus
PT

News of Manufacturers



HIGH-VOLTAGE LAB, with high-bay ceiling, dominates center's main building. Lab's interior (right) is shown during flashover tests on string of 10-in. insulators



TEST TRANSFORMER (60 cps) is at left; 2.4-Mv impulse generator is at right

Chance's R&D Center Now in Operation

The new engineering research center, constructed by A. B. Chance Co during the past winter and spring, has now swung into full operation.

The center's high-voltage laboratory dominates the main building. This lab has a high-bay ceiling extending to 62 ft to accommodate the 2,400-kv impulse generator. Sixty-cycle dielectric test transformers, with a 1,000-kv capacity, are also located in this laboratory.

A short-circuit laboratory, to test protective devices, switchgear and other apparatus, includes a 762,000-kva generator, plus a test substation with two single-phase, 200,000-kva short-circuit transformers. The substation and testing circuits were designed by Chance engineering personnel.

Other facilities in the center include mechanical, plastics, heat run, environmental, fuse-link and electrical-measurement laboratories. The latter area includes calibration equipment to insure the accuracy of all testing instruments. A model shop is also a part of the research center. Outdoor mechanical and electrical test areas are located adjacent to the engineering research buildings.

The two-building research center contains 32,000 sq ft of office and laboratory space on an 18-acre tract located near the company's general offices in Centralia, Mo.

The facilities of this new research center are currently being made available to utilities, engineering colleges and other manufacturers serving the electrical industry. Utility personnel are invited to visit.

S&C 138-Kv Circuit Switcher Is Field Tested

Recently completed tests, jointly conducted by S&C Electric Co and American Electric Power Service Corp, demonstrated the ability of S&C type "G" circuit switchers to interrupt fault currents within 5½ cycles, de-energize 125 miles of 138-kv line without restriking, and interrupt 130 Mva in a 138-kv loop circuit without causing incorrect operation of carrier ground relays.

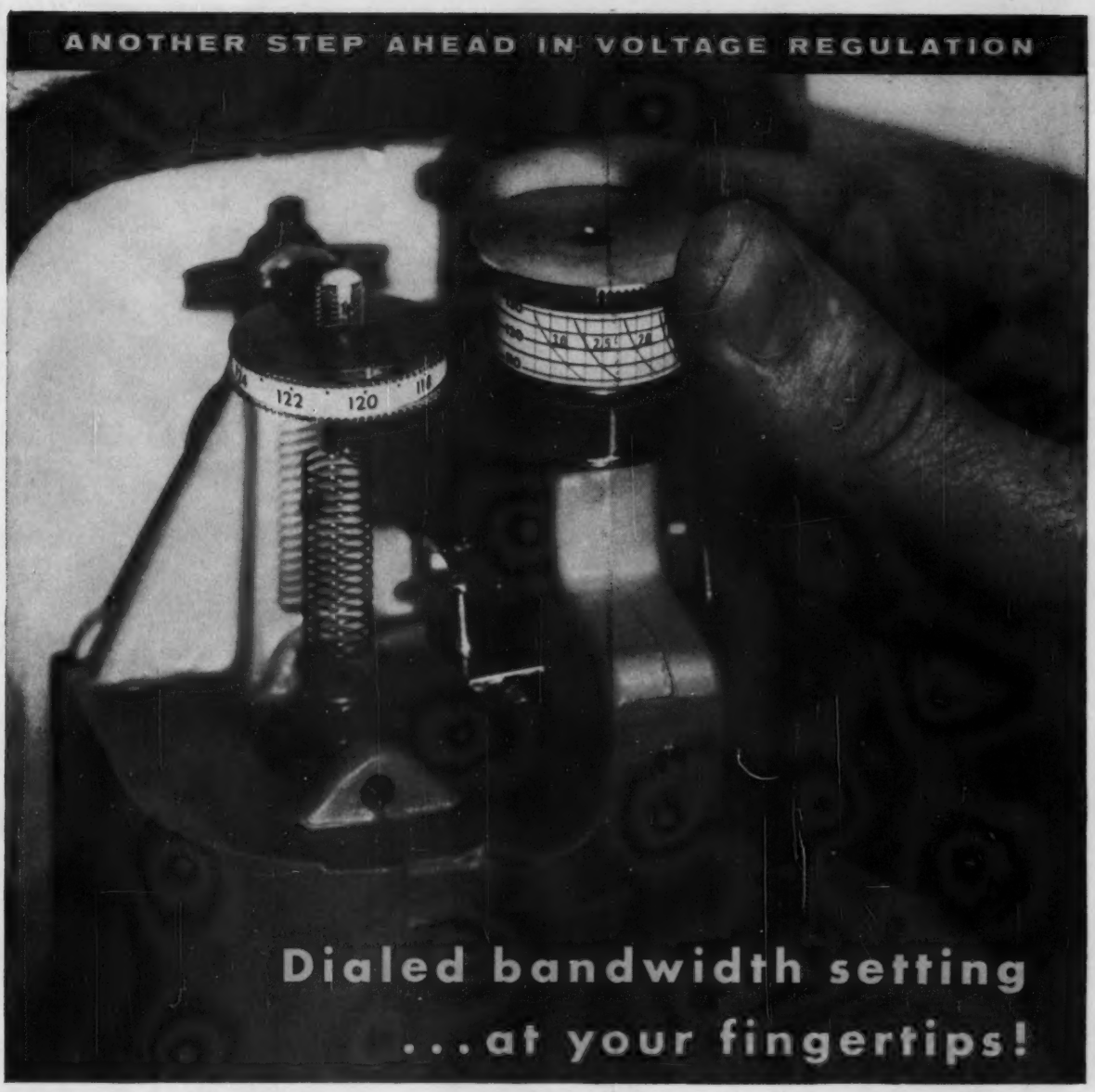
The "circuit switcher" superficially resembles an ordinary gang-operated airbreak disconnect but has totally enclosed interrupters which operate integrally with the disconnect blades. Double-gap type "G" interrupter units were used for line-dropping and loop-switching tests; single-gap type "G" units for fault tests. All tests were conducted on the effectively grounded 138-kv system connected to Clinch River Plant of Appalachian Power Co. Sixteen line-to-ground faults, in excess of 2,000 amp, were applied to the same pole. On the final test the switch successfully interrupted 5,950 amp with an arcing time of 1.1 cycles after clearing an aggregate of 4,200 amp on previous tests. Recovery voltage frequencies up to 1,600 cycles were recorded. According to the manufacturer, additional tests will have to be conducted to establish other maximum fault interrupting capabilities where more severe recovery voltage frequencies are encountered, such as interrupting on the primary of a transformer faulted on the secondary.

During two tests the switch was closed into a 4,360-amp fault and opened by an auxiliary shunt trip device. Faults were cleared within 5½ cycles.

Line dropping operations were

(*Continued on page* 88)

ANOTHER STEP AHEAD IN VOLTAGE REGULATION



G-E Micro-Band* relay: first to permit fast, accurate setting of both regulator voltage level and bandwidth

Now, with General Electric single- and three-phase step voltage regulators, you can dial optimum voltage level *and* bandwidth *in seconds . . . with micrometer accuracy!*

This important new advantage results from G.E.'s Micro-Band voltage-regulating relay—the first in the industry to offer you a dialed calibration of *both* these vital adjustments.

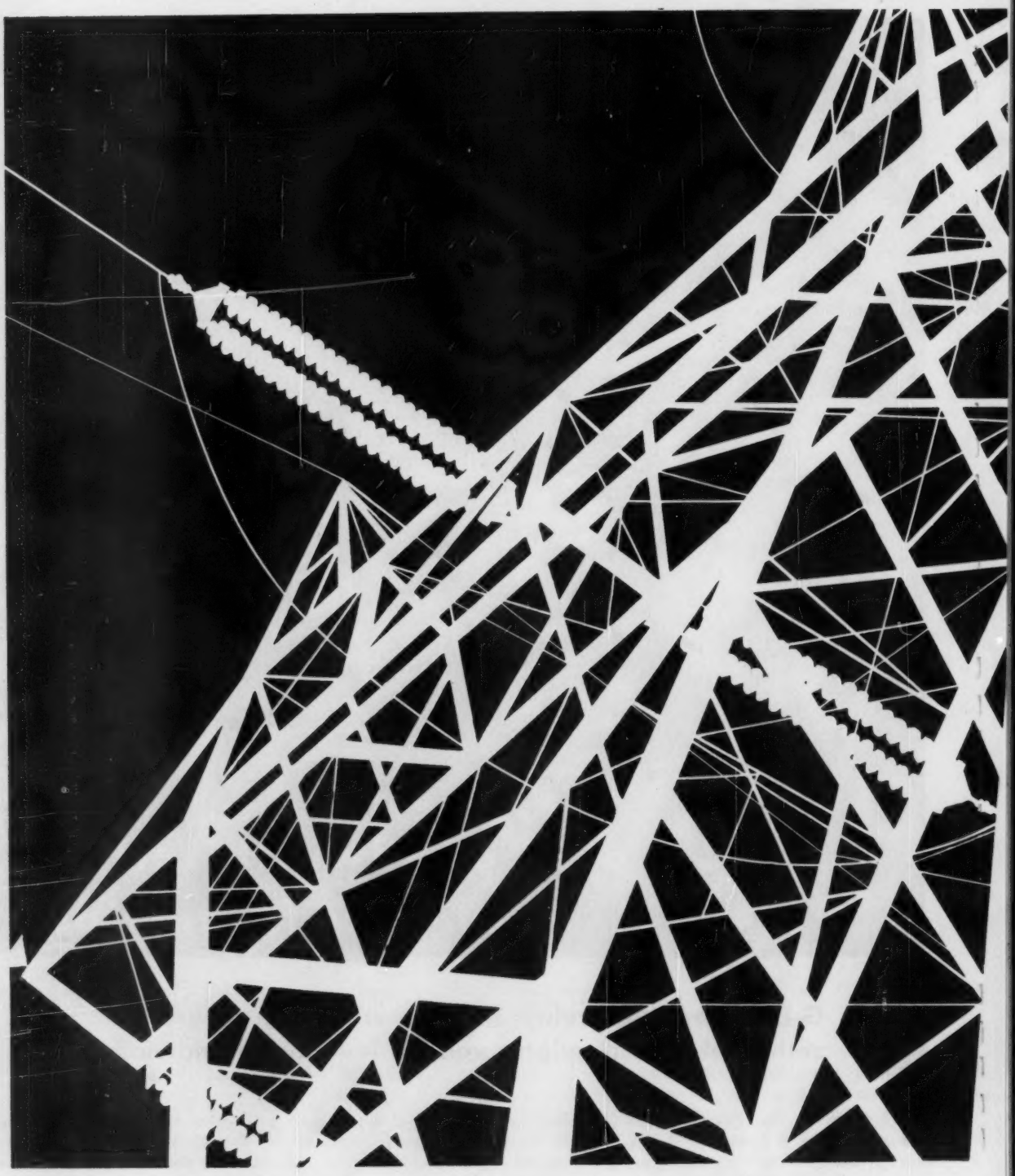
Micro-Band relay saves you time and money by eliminating the guesswork and painstaking procedures normally involved in making regulator adjustments. What's more, this *full* calibration permits precise coordination of voltage level and bandwidth setting with General Electric's highly flexible time-delay control. Thus, you take full advantage of the reduced bandwidths possible with General Electric regulators—bandwidths proven by recent computer studies to offer you increased system earnings at no sacrifice of regulator life.

Your General Electric regulator representative has complete information on the new Micro-Band relay and can show you how to achieve system savings through reduced regulator bandwidths. Call him today. Or write General Electric Company, Section 456-08, Schenectady 5, N. Y. *Voltage Regulator Products Section, Pittsfield, Mass.*

* *Trade-mark of General Electric Co.*

Progress Is Our Most Important Product

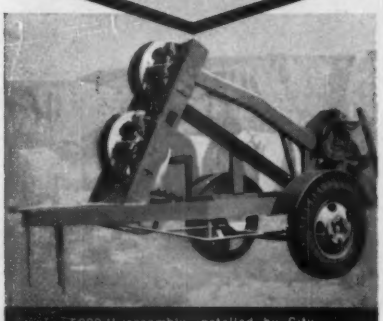
GENERAL ELECTRIC



TRANSMISSION: At every voltage level, lines are strained to the utmost as utilities increase capability to meet demand. ☐ General Cable research teams work constantly with the problems of this higher capability. Improved insulation... cable design... EHV transmission—these are a few of the problems now being investigated. Coupled with these are well-balanced manufacturing and supply facilities—all aimed to assure you of the finest wire and cable products. General Cable Corporation, 730 Third Avenue, New York 17, N. Y.

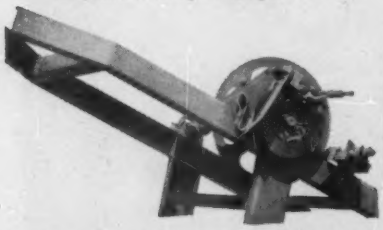
GCC
GENERAL CABLE CORPORATION

Now—Convert your own Reel Dolly to a Bullwheel Tensioner
WITH A
PENGO
5000-U Assembly



5000-U assembly installed by City of Medicine Hat Alberta Canada

Here's an easy way to build up a modern bullwheel tensioner at low cost—simply install a PENGO 5000-U Bullwheel Assembly to your old trailer or reel dolly. You'll have a tensioner with Neoprene-lined 26" bullwheels, capable of handling practically any distribution line stringing job at tensions to 2,000 lbs. at up to 4 mph.



Support arms, reel spindle with reel brake, and hand rewind assembly. 2¾" spindle will handle reels to 75" diameter, 44" width unless reduced to fit your trailer.

Bullwheel and tension brake assembly may be purchased separately.

We invite you to write or wire for literature, prices—please address Dept. 124.

PETERSEN
ENGINEERING COMPANY, INC.
Santa Clara, California
Phone: AXminster 6-7712

16

Circuit Switcher Tested

(*Continued from page* 84)

carried out with 138-kv circuits switched in series to provide a 125-mile line. Twenty-three switching close-open operations were performed. Cathode-ray oscillographs taken of several closing operations showed no serious transient voltages. All opening operations were made without restrikes.

On the loop-switching tests the switcher consistently opened the three phases within 1½ cycles of each other at currents up to 540 amp. Observation of product-type carrier ground relays on the circuit showed no movement of their contacts.

TVA Awards Boiler-Control Contract to Republic

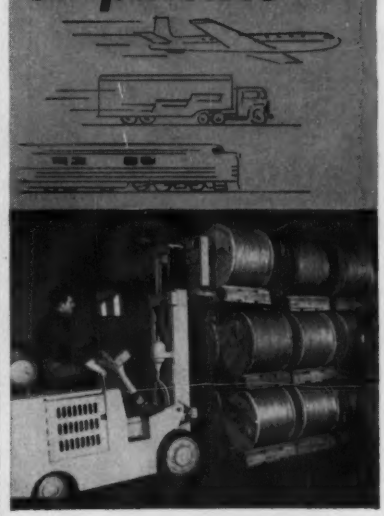
Republic Flow Meters Co, subsidiary of Rockwell Manufacturing Co, has been awarded the prime contract by Tennessee Valley Authority for the solid-state electronic boiler-control systems for Paradise Station. The Rockwell-Republic contract includes the automatic combustion, feedwater and superheat-steam-temperature control systems, analog instrumentation and digital computers. TRW Computers Co, division of Thompson Ramo Wooldridge Inc, will supply Republic with the two digital-control computers.

Paradise Station will utilize once-through boilers, each with continuous capacity of 4,900,000 lb per hr, operating at 2,450 psig, 1,053F superheat temperature and 1,003F reheat temperature, to supply twin 650-Mw turbine-generators. For the first time at any TVA generating station, the digital computer system will automatically control the turbine-generators, sequence monitor the steam generators, and will sequence cold start, hot restart, normal shutdown, or emergency shutdown of the units. In addition, the system will perform sensor scanning and alarm monitoring, data logging, trend recording and perfomance calculations.

The Paradise Station Units No. 1 and 2 will produce a total of

(*Continued on page* 90)

Prompt Emergency Shipments



Crapo
GALVANIZED
STEEL STRAND

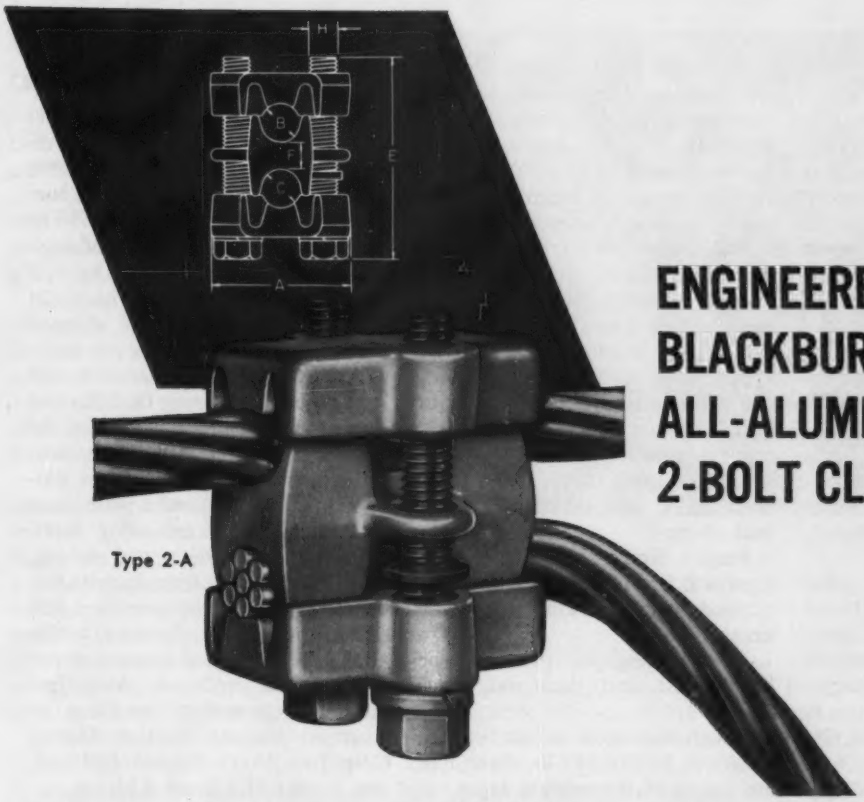
When in need of guy or messenger strand during an emergency, be sure to contact the nearest distributor of ***Crapo*** Galvanized Strand! Substantial stocks are maintained at strategic distributing points throughout the country ready for immediate delivery. Back of these stocks are our own extensive mill stocks of finished strand, and strand in process. If your jobber does not have all of your requirements, he knows he can depend upon us for immediate shipment of popular sizes and grades by air, truck or rail.

You, in turn, can rely upon ***Crapo*** Galvanized Steel Strand, at all times, to give you the utmost in performance at reasonable cost.

Crapo Galvanized Steel Strand is manufactured in all standard sizes and grades and in three weights of coating: Class A, B and C.

Phone the distributor of *Crapo* Galvanized Steel Strand near you the next time you need strand.

INDIANA
Steel & Wire Co., Inc.
Muncie, Indiana



ENGINEERED INTO BLACKBURN ALL-ALUMINUM 2-BOLT CLAMPS...

ALL WEATHER PROTECTION

On Aluminum or Bi-Metallic Connections

Contact surfaces guarded by rainshield design of castings—inhibitor will not "wash out" even under driving wind and rain.

Condensation is drained off through ports in castings regardless of installation position—never allowed to accumulate around the conductors.

Designed with hot stick crews in mind.

Massive all-aluminum clamp—including hardware—may be used on aluminum or on copper conductors with inhibiting compound. Extra thick, highly conductive aluminum spacer separates dissimilar conductors for added corrosion protection.

Four clamps accommodate a wide range of wire sizes—main from 6 to 795 ACSR, tap from 8 to 397.5 ACSR. Write for samples and literature.

LIVE BETTER ELECTRICALLY

For complete information and test data: Send for Bulletin #6003

Jasper BLACKBURN Corporation

1525 Woodson Road • St. Louis 14, Mo.

TVA Awards Contract

(*Continued from page* 88)

1,300 Mw of power and reportedly will be the largest power-generating installation in the US. The first unit is scheduled to begin commercial operation in the third quarter of 1962 and the second unit about a year later.

'Vacuum-Cast Ingot' for 800-Mw Rotor Is Poured

Bethlehem Steel Co, at its Bethlehem, Pa., plant, recently successfully poured the largest vacuum-cast ingot ever attempted (EW, May 1, p 46).

Four electric furnaces were tapped to supply 535,000 lb of nickel-molybdenum-vanadium alloy steel for the ingot which will be forged into the world's largest single-piece generator rotor. This rotor is destined for an 800-Mw steam turbine which General Electric Co is building for the Tennessee Valley Authority.

The ingot, eight tons heavier than any previously cast, was poured—from beginning of first furnace pouring until the final heat from the fourth furnace entered the 270-ton capacity degassing chamber—in 36 min, 15 sec. A special mold designed to pour the ingot was 120 in. in dia and 175 in. high.

In the actual forging process, the ingot will be brought to a uniform temperature of about 2,300F, over a period of approximately 80 hr, and then worked for nearly an hour in a 7,500-ton press forge. It will next be reheated for from 20 to 24 hr and returned to the press forge for another 2½ hr to receive its final shaping.

Forged dimensions of the rotor ingot will be: body diameter, 67¾ in.; body length, 284½ in.; over-all length, 510 in.

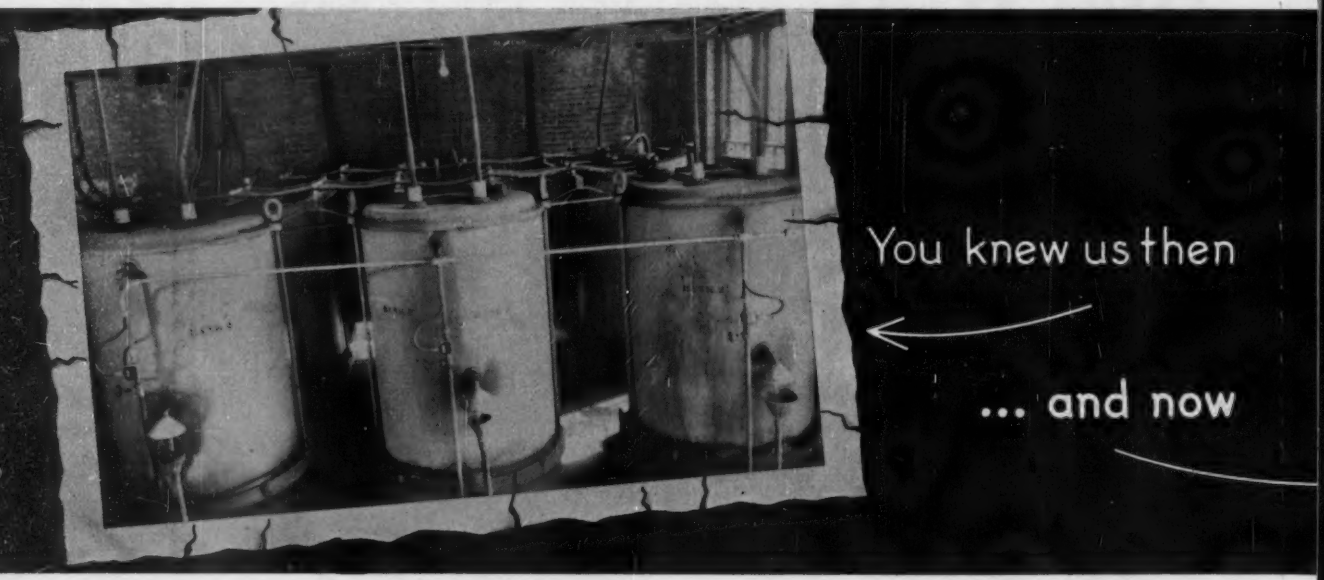
After forging, the piece will be heat-treated and then rough-machined.

Rough-machined weight of the piece will be 288,917 lb, about half the weight of the original ingot.

Alcoa Has 51% Ownership In New Australian Complex

Aluminum Co of America has founded Alcoa of Australia Proprietary Ltd to establish and operate a $100-million integrated aluminum complex. To be owned 51% by Alcoa and 49% by a group of leading Australian mining companies, it will begin operations within 24 months. Alumina will be shipped abroad, after local needs are met.

At year's end, construction will start on bauxite mining facilities and a refining plant in the vicinity of the city of Perth on Australia's west coast, a smelter for aluminum production at Geelong and a plant there to fabricate aluminum alloy sheet, foil, extruded shapes and tubing. Alumina extracted from bauxite will be transported by sea over the 1,700 miles from Perth to Geelong, where 40,000 long tons of aluminum per year will be produced. Australian interests represented in Alcoa of Australia include Western Mining Corp Ltd, North Broken Hill Ltd, and Broken Hill South Ltd.



Allis-Chalmers sets the pace for power transformer

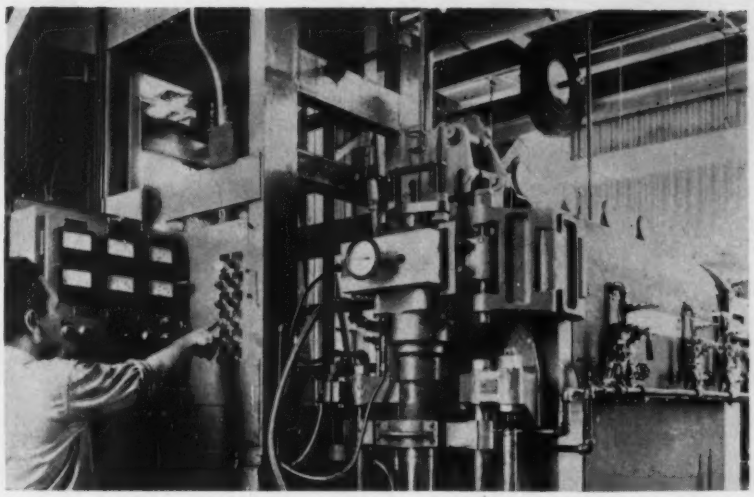
Recall these Allis-Chalmers veteran power transformers? One remarkable fact about them — after 50 years, these transformers are still in active service at the Jordan Steam Plant of Utah Power and Light Company.

Longevity like this is more concrete evidence of Allis-Chalmers long-standing philosophy — design in *more real value* per equipment dollar.

And in 1961 we continue to meet this stiff, self-imposed challenge. It's why we can say proof of A-C value is in our products. Examples: Power transformers that are 30% lower and lighter than the previous design • Distribution transformers capable of delivering a 12% increase in capacity at 65 C rise without loss of life • *Regu/Tran* — a new concept that provides single-phase regulation with provision

Regu/Tran is an Allis-Chalmers trademark.

Vertical Vulcanizer to Begin Operation at Kaiser



Extensive, new vulcanizing equipment at Kaiser Aluminum & Chemical Corp's plant in Bristol, R. I., is now providing the company with one of the most modern facilities for insulating copper and aluminum electrical conductors.

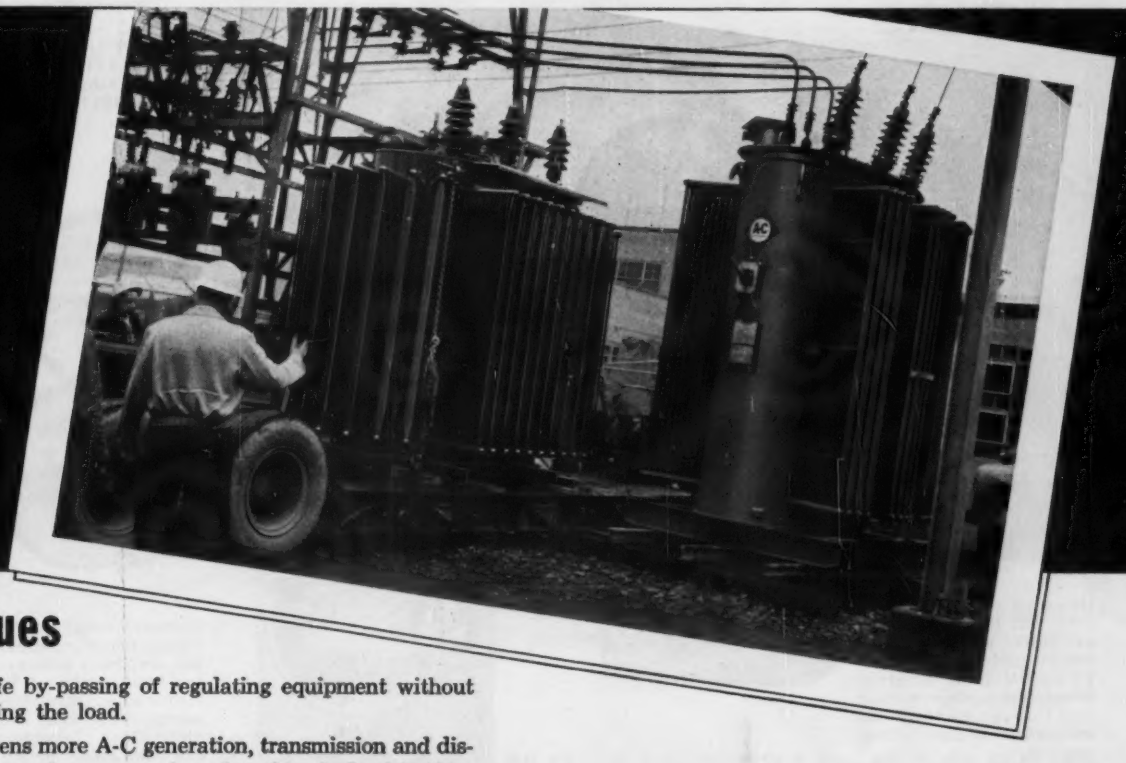
Known as a vertical continuous vulcanizer, the line of equipment is housed in a 126-ft tower located near the center of the Bristol works. It reportedly represents the tallest and largest vertical "CV" machine in existence.

Natural and synthetic-rubber insulating materials are extruded around preheated conductor cable at the top of the tower and cured in a 75-ft high-pressure steam vulcanizing tube which extends downward. The cable then continues through a water-cooling tube at the same high-pressure level to improve density of the insulating material.

After traveling vertically, the insulated cable turns on a capstan and is cooled further in a 65-ft horizontal water tube before being hauled onto a take-up reel at ground level.

The new equipment enables Kaiser Aluminum to insulate larger cables than before—up to 3½ in. in dia after insulation is applied—reportedly with a high degree of control over surface characteristics, density, centering and roundness. In addition, the vulcanizer is capable of handling conductor lengths up to 3,000 ft: sufficient for virtually any presently known requirement.

Kaiser Aluminum will use the facility for insulating and curing portable cables, building wire and power cables from 600 to 35,000 v.



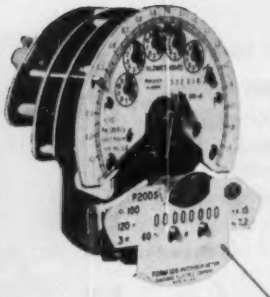
values

for safe by-passing of regulating equipment without dropping the load.

Dozens more A-C generation, transmission and distribution advances are keyed to this single objective: To *economically* resolve utilities' mushrooming system power expansion problems. *Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.*

ALLIS-CHALMERS

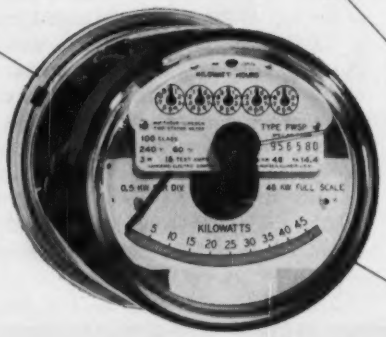
A-1489



DR (dual range) mechanical demand registers reduce register change-outs, cut inventory costs, let you double the demand range as the load grows.

Sangamo's P20 and P30 are the most modern and advanced two and three stator meters. They provide the highly sustained accuracy needed to better measure today's large loads.

NEW VALUES IN POLYPHASE METERING



PW (combination kwh/thermal kw demand meters) have dual range designed to keep abreast of your growing loads.

Universal metering equipment with the P60S universal meter and UM meter mounts (UM-1 with CT's and PT's—UM-2 for external transformers) attain real savings through standardized metering on all conventional services.

Sangamo Autopass metering equipment provides positive secondary circuit opening and closing on transformer-rated installations. It combines "C" base 2 and 3 stator Class 10 meters with the UM-2 meter mount.

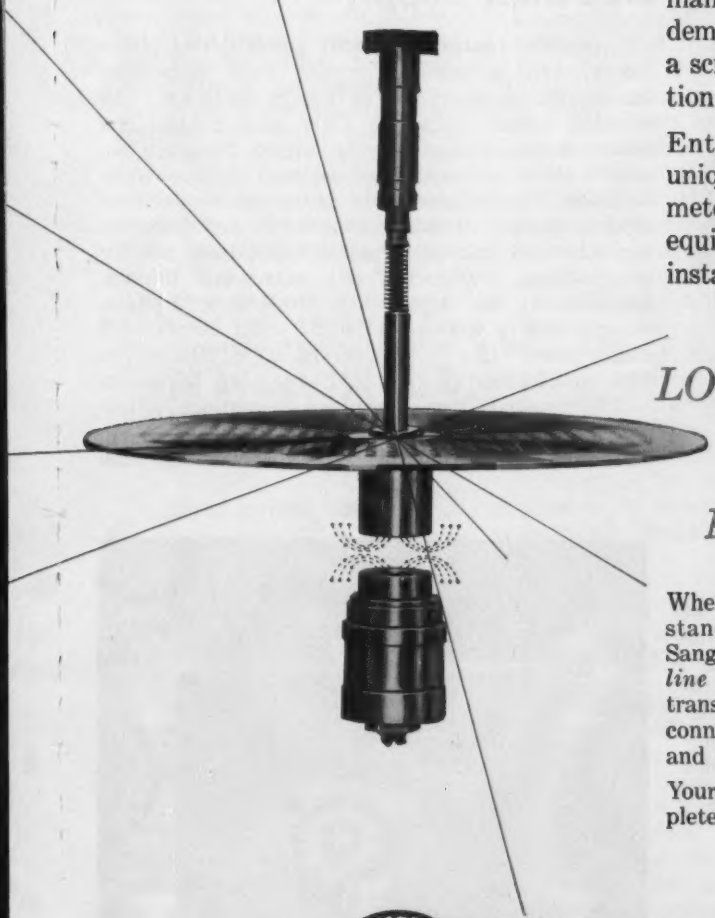
Take a look at what's new in polyphase metering—the most complete, most advanced line of meters and associated equipment! Developed by Sangamo to meet your current needs and to anticipate your future requirements.

P40 meters measure kvar hours and P50 meters measure kva hours without the use of external phase-shifting transformers. Both can be equipped with mechanical demand registers.

All of these two and three stator meters have *true magnetic flotation* . . . the moving system that floats freely and permanently on a magnetic field created by specially bonded Alnico magnets. All retain the proven Sangamo advantages of slow speed and high torque to give you polyphase meters with unexcelled sustained accuracy. All are small and compact—the P30, for example, is the lightest, smallest three stator meter . . . the only one with single disk, round cover design. All feature sectionalized construction, interchangeable components, and easy-to-use adjustments.

Dual range mechanical demand registers are available for every type, and most thermal demand meters feature dual range. On Sangamo demand meters, you can double the range with a screwdriver, quickly and easily—no recalibration is necessary.

Entirely new metering concepts offer many unique benefits. Investigate Sangamo's universal meter and meter mounts. Consider Autopass equipment for your polyphase transformer-rated installations . . .



LOOK TO SANGAMO FIRST for all of your polyphase metering needs

When you need polyphase meters, remember the outstanding values that are yours when you specify Sangamo. Remember also that this is *the most complete line* of kwh, kvarhr and kvahr self-contained and transformer-rated meters, in both socket and bottom-connected construction, with dual range mechanical and thermal demand.

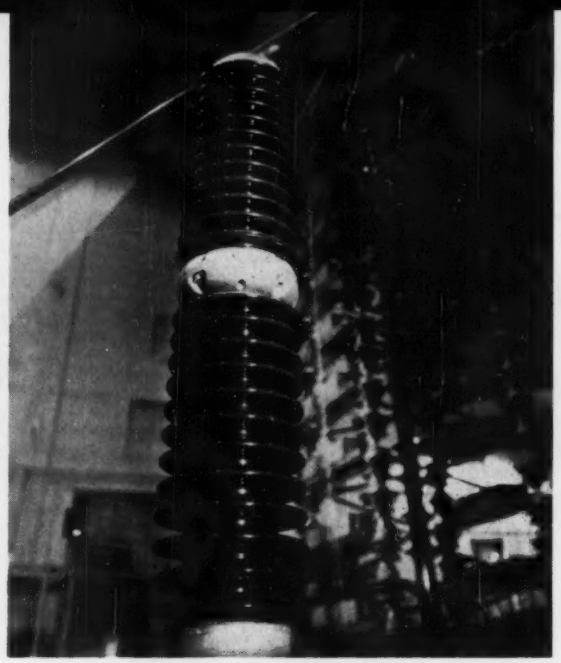
Your Sangamo Representative can give you the complete story on these new developments.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

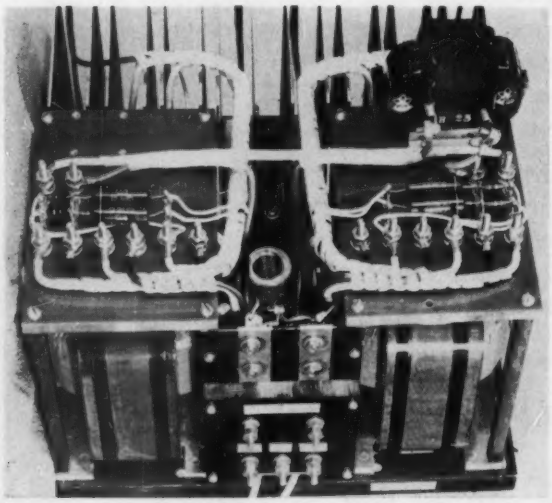
PW61-7

New Equipment

Station Post Insulators . . .



. . . features an effective metal-polymer seal which prevents air-moisture leakage. Available in standard, high-strength and extra-high-strength BIL ratings of 550 kv through 1,470 kv, the Locke station stacking post insulators are for use on switches, as bus supports, etc. on system voltages of 115 kv through 345 kv. Extensive testing has proved the metal-polymer seal to be completely effective and leak-free thus eliminating the danger of moisture leakage inherent in rubber plug seals which tend to wrinkle and deteriorate. All ratings of the new line, both type A conventional and type B fully interchangeable units, are now in production.
General Electric Co, Schenectady 5, N.Y.

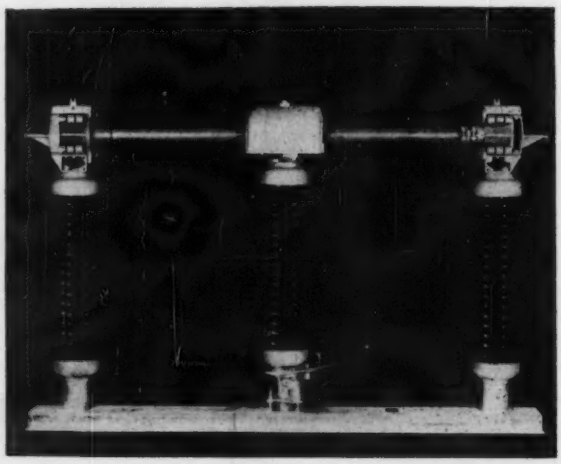


Ac Power Supply . . .

. . . provides controlled standby power during power failure, and is said to prevent even momentary interruption in equipment or system operation. The complete system includes a TRW static charger and battery in combination with the inverter chassis. Connection to the ac power line and load is the only installation. Components of the system are available on separate chassis, or can be supplied in a single package relay-rack cabinet. Typical applications are for power plant instruments and microwave stations. Specifications are: input—115/220/440 v, 3-phase, 60 cps; battery voltage—43 to 56 v dc; output—2.5 kva, 1 phase, 115 v $\pm$ ½ v, 60 cps $\pm$1%; efficiency—80% at f.1.; load pf—0.6 lead to 0.5 lag; harmonics—5% nominal; duty—continuous; starting—instantaneous.
Thompson Ramo Wooldridge, Inc, Cleveland 17, Ohio

Center-Rotating Switch . . .

. . . available in nominal ratings from 34.5 to 345 kv—in 600, 1,200, 1,600 and 2,000-amp continuous—are double-break, group-operated. The R-17 switch has the Magne-Loop contact jaw, now standard on all the company's verticle-break switches. Blade-rotating mechanism, covered with a sturdy shield, protects against ice and sleet. This switch is designed for use where vertical clearances present a problem.
Memco Engineering & Manufacturing Co, Inc, Commack, Long Island, N. Y.



(More New Equipment on page 95)

This CHANCE Fuse

waves a RED FLAG to signal Capacitor Failure!

... Prevents tank rupture

The Chance CTS Fuse for secondary systems gives you positive operation with a distinctive signal of capacitor failure. When the fuse element melts, the indicator flag springs away from the cartridge automatically ... stands out like a sore thumb so linemen and patrol crews can easily spot a failed capacitor from the ground. The fuse is equally effective on upright or underhung capacitors, and the flag works regardless of the position or angle of the fuse.

The fuse element is precision made and well protected by the rugged construction of the cap-sealed fuse tube. You get no false outages, but you do get instant isolation of failed capacitors to protect secondary systems *and prevent hazardous tank rupture.*

Ideal protection for banked secondary systems

Chance Secondary Fuses, used between banked transformer secondaries, permit only one transformer and its load to be taken out of service if a secondary fault occurs. This prevents possible damage to the other transformers, or cascading of the fuses protecting these transformers.

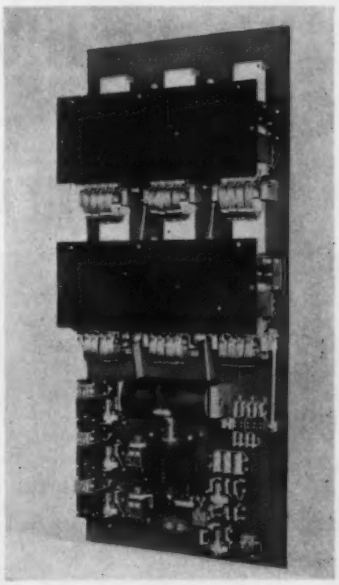
You can get complete information, and performance curves of the CTS or CTSI (Insulated Leads) Fuse, by contacting your Chance Man or writing direct.

CF60-33

A. B. CHANCE CO.

CENTRALIA, MISSOURI

(A. B. Chance Company of Canada, Ltd., Toronto)



Transfer Switches . . .

. . . featuring mechanically-held, automatic-transfer action are available in 1,200, 1,600 and 2,000 amp. These two and three-pole switches, to 600-v ac and 250-v dc, are open-type, minimum-width, vertical-tandem units which are said to be particularly suitable for control centers. Special voltages to 750 v at special frequencies can be specified. Full relay protection on each switch provides for transfer to the emergency source when voltage on any phase drops to 70% or less. Retransfer to the normal will be made when all phase voltages are 90% or more. Normal voltage is supervised across live lines on single-phase or dc, three-wire systems. **Automatic Switch Co, Florham Park, N. J.**

All-Fiberglas Boom . . .

. . . for all Skyworker aerial lifts, has "spade-end" contour at outer end which permits embedding of all sheaves, bearings and other mechanisms within housing portion of the boom. This design is said to allow construction of glass unit at no sacrifice of the most rigid safety standards. Boom is constructed of high modulus, woven roving cloth impregnated

(*Continued on page* 98)

Searching for Meter Sockets?

look to . . .

SUPERIOR

SWITCHBOARD & DEVICES CO.

CANTON 1, OHIO

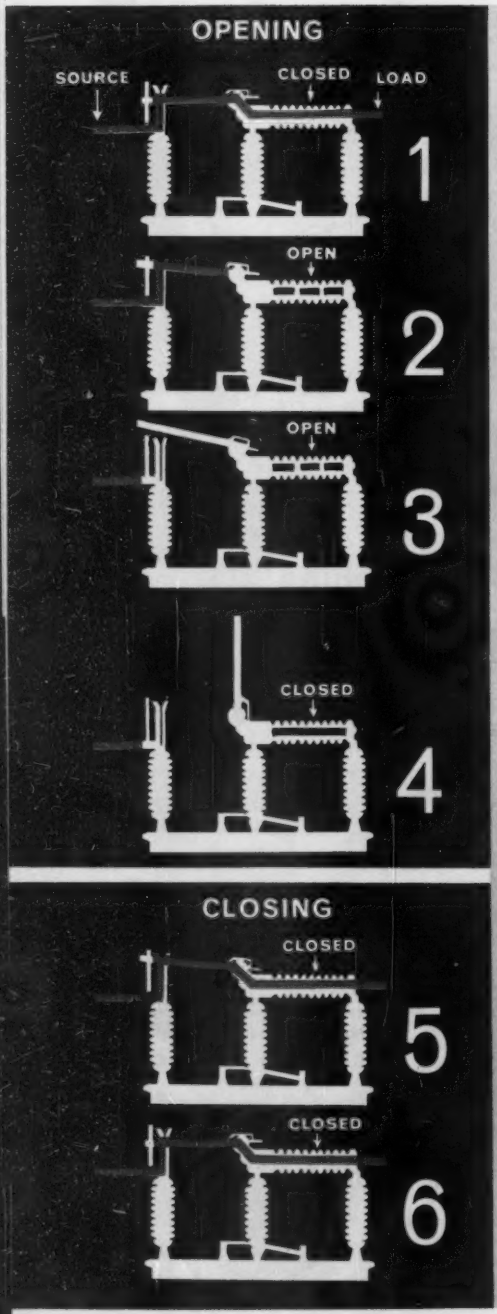
A Subsidiary of

The Union Metal Manufacturing Co.

Drawn Ringless Socket

Write for a free Catalog outlining types and sizes of meter socket equipment, test switches, test blocks, reactiformers and enclosures.

Works like a circuit breaker—looks like an interrupter switch



This is Circuit-Switcher. Costs less than a circuit breaker. Outperforms an interrupter switch.

Circuit-Switcher is the generic name for a new family of switchgear for handling a number of circuit interrupting duties on transmission systems. It's a cross between an interrupter switch and a circuit breaker. A significant feature of Circuit-Switcher is that it is mechanically programmed to fit high-voltage switching environments, whether breaking or making the circuit.

PROGRAMMED CIRCUIT BREAKING

1. When Circuit-Switcher is in the closed position, the interrupting section carries the continuous current and withstands short-time surges—like a breaker.
2. As Circuit-Switcher starts to open, the "brain" mechanism (with its built-in sequence control and stored energy) trips the interrupting section, opening the circuit—like a breaker.
3. Now the "brain" moves the disconnect blade toward the open position to establish a visible air gap—like an interrupter switch. But unlike an interrupter switch, the blade is not burdened with shunting, actuating, and driving an interrupting unit.
4. As the disconnect blade approaches the fully open position, the "brain" recloses and recocks the interrupting section, unlike the interrupter switch which must recock at the most adverse loading point in its closing cycle.

PROGRAMMED CIRCUIT MAKING

5. As "brain" closes the blade, inrush current (or fault current) is picked up at the jaw . . . not in interrupting section. Unlike the interrupter switch, the blade closes at high speed, unimpeded by having to reclose and recock an interrupting unit.
6. Circuit-Switcher is completely closed—ready for the next opening cycle.

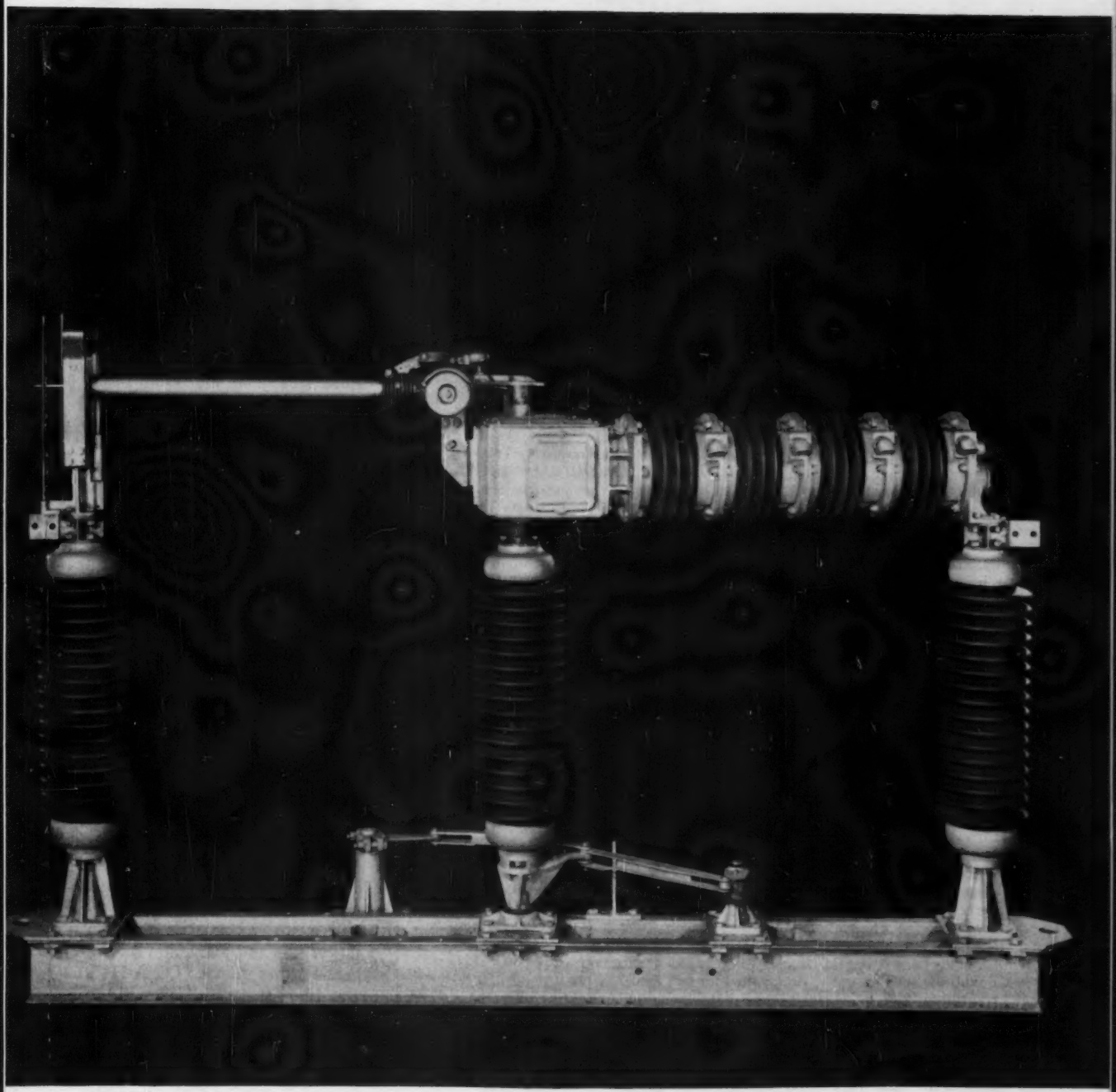
With the guts to do the job

Like a circuit breaker, Circuit-Switcher's vital close and trip mechanisms are fully enclosed and protected. Unlike an interrupter switch, there is no gingerbread—no external shunts, triggers, cams, and levers—to freeze up, burn up, jam up, or goof up.

Operation is "Goof-Proof"

The correlation of interrupting section action, disconnect blade action, and operating handle action is pre-scheduled by the "brain" mechanism. Any operating procedure—such as reversing direction in "midstream"—will not result in improper sequencing of interrupting section and disconnect blade.

S&C ELECTRIC COMPANY
4421 Ravenswood Avenue • Chicago 40, Illinois
Specialists in High Voltage Circuit Interruption since 1911



NEW GENERAL ELECTRIC

Transistorized Analog

FREQUENCY TELEMETERING OFFERS GREATER SPEED OF RESPONSE, INCREASED ACCURACY

Now available! General Electric's all-new Analog Frequency Telemetering System provides greatest possible *FLEXIBILITY* to meet utility load dispatching and industrial data transmission applications.

Universal design can be easily modified for varying applications resulting in system simplicity and flexibility. Manufacturing standardization assures quick delivery.

Optional plug-in audio-tone equipment permits transmission of data over voice or microwave channels where tone frequencies are required. Optional tone transmitter and receiver offer forty different tone frequencies available with conventional shift-type operation.

Completely transistorized system has *no* vacuum tubes. Telemeter transmitter, tone transmitter and receiver use only transistors in their circuitry. Telemeter receiver utilizes only diodes.

Compact System rack mounts—conserves valuable panel space.

Plug-in application adapters determine input range and output signals for both the transmitter and receiver. Plug-in filters and transformers select tone frequencies.

Combined accuracy of transmitter and receiver is ±0.5 percent of full span over these variations: ± 15°C temperature, ± 5 percent voltage change, ± 3 cycles frequency. A combined accuracy of ± 1 percent of full span is assured even when the transmitter is subjected to −20 to 55°C or ± 10 percent voltage change.

System stability—±0.5 percent of full span in six months plus ±0.1 percent of full span per each subsequent six months.

Quick response—system speed of response is rated 1 second for 99 percent of scale range—practically instantaneous. Such response is invaluable in applications involving load-frequency control wherein high-speed response is essential. In addition, there is no overshoot.

For utility telemetering in transmitting rapid fluctuation of electrical quantities such as watts, vars, volts and amperes . . . for fast positive transmission of industrial process data including quantities of pressure, temperature, liquid level, flow and many others . . . check into the cost saving advantages of G.E.'s new Analog Frequency System today. Your nearest G-E sales representative will be glad to provide you with additional information on this all-new low cost system. Be sure to ask for bulletin GEA-7163, or write direct to General Electric Company, Section 599-07, Schenectady 5, N. Y.

INSTRUMENT DEPARTMENT

GENERAL ELECTRIC

with self-extinguishing polyester resin. At work platform or outer end of the boom, bearings and idler sheaves are nylon—which is said to eliminate greasing and dirt contamination. Drive sheave at leveling system is protected at wear surfaces by dry lubrication. The Fiberglas shaft and fewer metallic parts in the work platform area make maximum flashover gap possible. The complete line of Skyworker hydraulic aerial lifts was acquired recently by Hughes-Keenan, including manufacturing, servicing, sales. **Hughes-Keenan Div, US Air Conditioning Corp, Box 360, Delaware, Ohio**

Insulating Oil . . .

. . . for transformers and circuit breakers has 300F flash point. It is reported to have improved heat transfer ability at high temperatures, and better flowability at low temperatures. Higher flash point, raised without disturbing its low 58 SUS/100F viscosity, is said to reduce evaporation losses and minimize fire hazard. Its good dielectric properties and better oxidation stability are reported to result in minimum power loss and maximum service life. Further, Sunoco Oil A-HT's wax-free structure is said to eliminate solidification at temperatures lower than —50F. The low-temperature viscosity, 280 SUS/32F, insures reliable operation of the circuit breaker, regardless of weather conditions. **Sun Oil Co, 1600 Walnut St, Philadelphia, Pa.**

Loading Transformer . . .

. . . may be used continuously at 5-kva output on 110 and 220-v connections, 50/60 cycles. Input taps on the new type CL-6 are provided for 90, 110, 180, and 220 v. The output currents are 1,000 amp (5 v) or 500 amp (10 v), continuous duty. On intermittent duty the output currents may be increased to 750

amp (10 v) and 1,500 amp (5 v) on a 40% duty cycle. Both the primary and secondary are insulated for a 4,000-v, 60-cycle one-min test. Weighing but 60 lb, the loading transformer can be widely used for testing and calibrating current-actuated protective and switching devices, current-carrying apparatus, and transformers.

Knopp Inc, 1307 66th St, Oakland 8, Calif.

Lamp Control Switch . . .

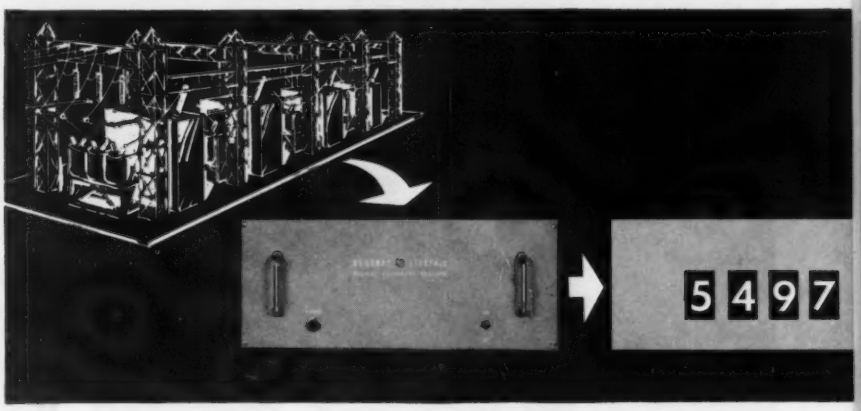
. . . is photo-electric, automatically turning lamps on at dusk and off at dawn without period resetting. Solatrol SPL-108 electronic switch is designed for mounting on street-lamp poles, crossarms, building sides and is said to offer safe, sure control of lighting loads up to 1,000 w. Switch is hermetically sealed against the weather and has a built-in time delay which prevents accidental switching by stray light. Housed in heavy-gage aluminum case finished in infra-red baked paint, unit comes pre-wired with bracket.

Solar Sonic Devices Inc, Old Country Rd and Railroad Ave, Hicksville, Long Island, N. Y.

NEW GENERAL ELECTRIC

Digital Telemetering

SYSTEM FOR FAST,
HIGH ACCURACY
DATA TRANSMISSION



For fastest, most accurate utility load or billing information, General Electric's all-new Digital Telemetering System brings kilowatt-hour information into load dispatching office over one channel, with *100 PERCENT ACCURACY*. Offers outstanding system values . . .

Flexibility: Digital telemetering signal can be time-multiplexed with an analog telemetering signal at a preset time interval, thus providing minimum channel expense and lower operating costs. Or the digital telemetering system can be used over its own isolated channel to transmit information on command. This system will also operate over any intermediate channel equipment capable of accommodating standard analog "frequency" telemetering signals.

Accuracy: Digital receiver self-checking feature permits only the read-out of correct numbers.The receiver will cancel the readout if there has been an incorrect code or interference of the coded signal during transmission.

Speed: Digital transmission is in the form of long and short pulses at average rate of 10 cps. A six digit number can be telemetered in less than five seconds.

Design: System utilizes time-proved relays and stepping switches that require minimum maintenance. No tubes or transistors are used. Equipment is furnished in 19-inch rack, dust-proof cases with slide-out drawers.

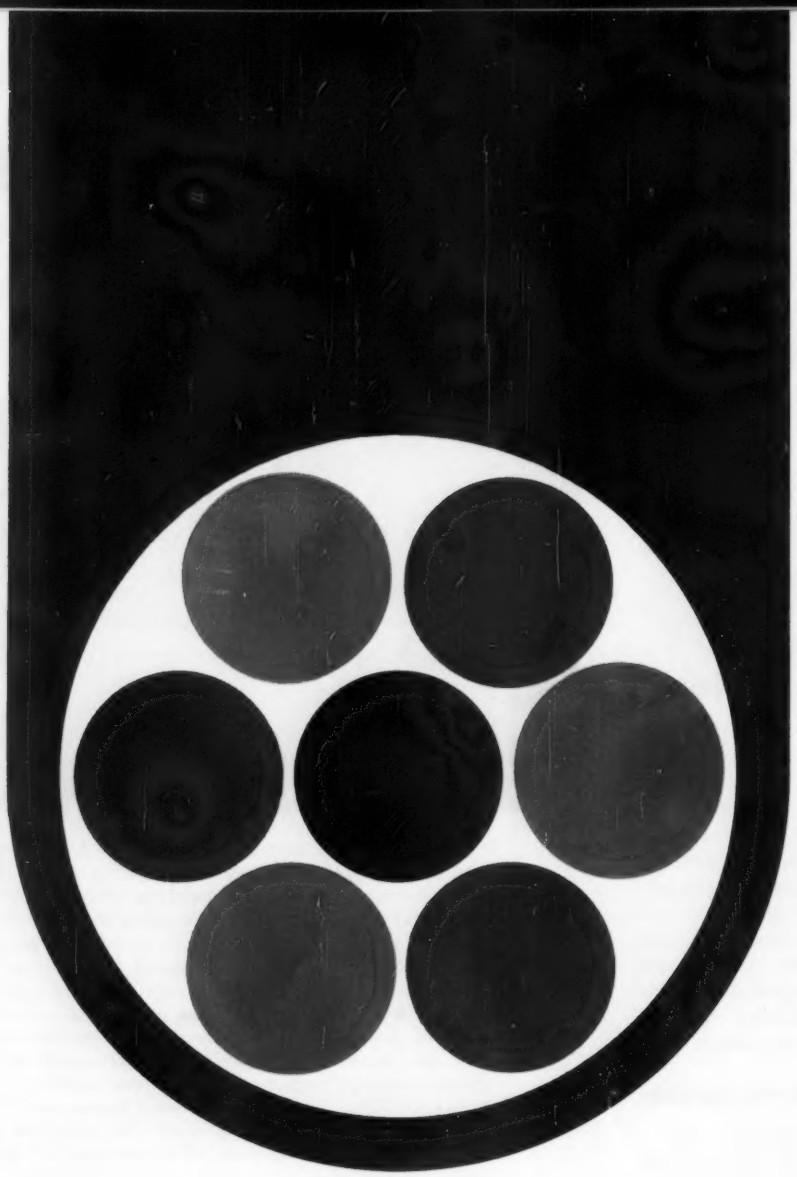
Cost: System price is usually less than the cost of comparable integrating devices which it now obsoletes.

Various read-out devices are available depending on your requirements. These include: electric typewriter, visual digital display units and tape punch equipment if you wish to use the information in a digital computer. Digital transmitters and receivers can be provided for either 4, 6 or 8 digit numbers.

For additional information on the all-new G-E Digital Telemetering System, just call your nearest General Electric sales office, ask for a copy of bulletin GEZ-3312, or write direct to General Electric Company, Section 599-07A, Schenectady 5, N. Y. In Canada, contact Canadian General Electric Company Ltd., 940 Lansdowne Avenue, Toronto 4, Ontario.

INSTRUMENT DEPARTMENT

GENERAL ELECTRIC



NEW WAY TO EVALUATE CABLE!

"VALUE RATINGS" RELATE PERFORMANCE TO IPCEA OR COMPETITIVE STANDARDS

New Value Ratings tell at a glance the composite story of each Kaiser Wire construction—as it performed in as many as 25 specified tests. In each case a well-known standard serves as 100%:

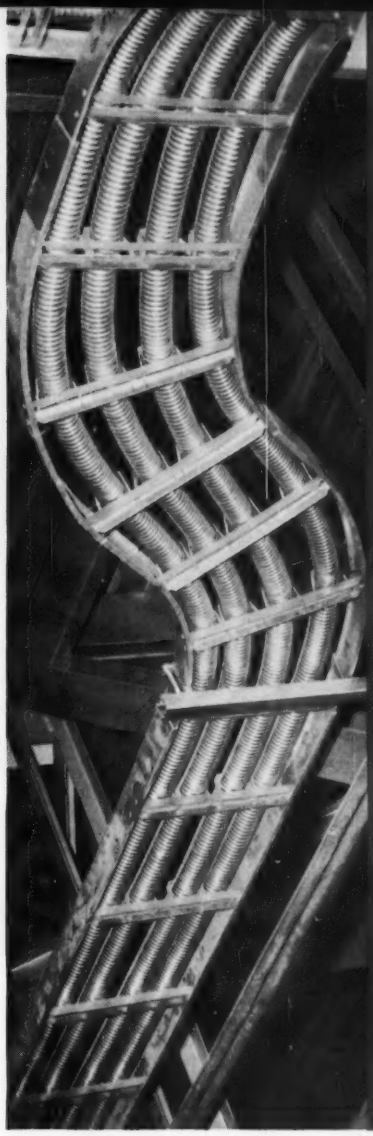
For power cable, the Value Rating standard is all IPCEA test requirements for types of insulation and jacketing specified . . . For portable cord, the standard is service-per-dollar for the least expensive cord (C.V.) as proved by life-expectancy tests.

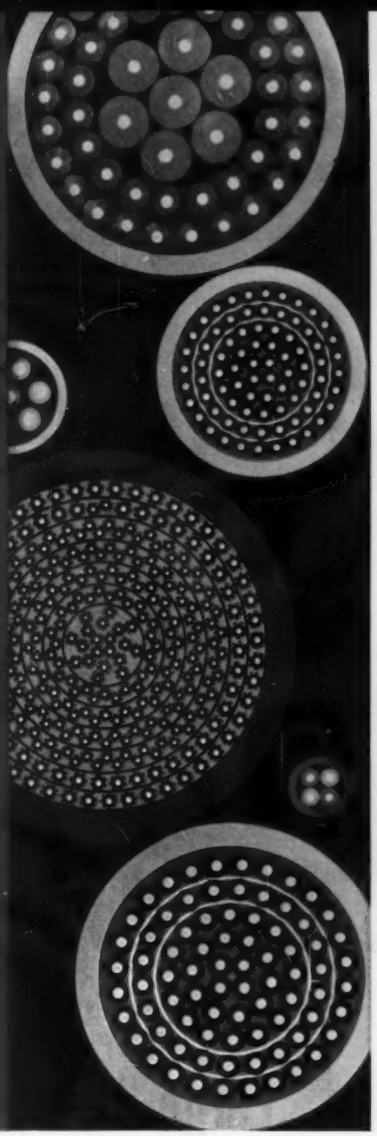
. . . For control cable, the standard is a composite of minimum requirements for eight important insulation qualities.

Compared to these standards, Kaiser Wire constructions earn Value Ratings as large as 767%—valid proof that the spark of quality is Kaiser Wire experience.

For details and Value Rating listings, ask your Kaiser Wire Distributor for free K/W Value Rating Bulletins, or write: Kaiser Wire, Room 844f, Kaiser Aluminum & Chemical Sales, Inc., Kaiser Center, 300 Lakeside Drive, Oakland 12, California.

KAISER ALUMINUM & CHEMICAL CORPORATION





KAISER INTERLOCKED ARMOR CABLE DISTRIBUTES POWER AT LOWER COST

It needs no conduit for protection. It is flexible, forms easily. And because of its light weight, K/W Aluminum Interlocked Armor Cable cuts installation costs. One hundred feet of this aluminum-armored cable in unshielded 5KV, 3-cdr, size 1/0 AWG, weighs only 125 lbs. compared to 234 lbs. for size 2, copper-conductor steel-armored. K/W aluminum-armored is corrosion resistant . . . and its insulation has nearly 20 times the ozone resistance required by IPCEA.

K/W ALUMINUM INTERLOCKED ARMOR CABLE
VALUE 363% RATING

KAISER PORTABLE CORD SAVES $22.24 IN ONE TOOL'S REPAIRS

A typical case shows how K/W Master Laytex portable cord can save $22.24 in maintenance—before a single repair. A new length of K/W Master Laytex cost the buyer $4.65; plus an estimated $6.00 labor to connect it. An equal length of "bargain" cord (low-priced C.V.) cost $2.89. But the latter was in and out for repairs five times—running up $30.00 labor—before K/W Master Laytex failed once. The net saving was $22.24 with K/W Master Laytex cord.

K/W MASTER LAYTEX PORTABLE CORD
VALUE 308% RATING

KAISER CONTROL CABLES OFFER WIDEST CHOICE OF INSULATIONS

Kaiser Wire offers the following broad range of control cable insulations . . . Thermoplastics: Polyethylene, Polyvinyl Chloride. Synthetic rubber: Pyrosec® (SBR), Hydrosec® (SBR), Oil base, Kalzone® (butyl), Silicone. Natural rubber: Kaiser Laytex®, the patented liquid latex covering unequalled for strength and dielectric qualities. Add neoprene or plastic jacketing, copper or aluminum conductor—and you can choose from hundreds of K/W cables of extra value!

K/W LAYTEX-RESIN CONTROL CABLE
VALUE 767% RATING

IN COPPER AND ALUMINUM CABLES . . . THE SPARK OF QUALITY IS KAISER WIRE EXPERIENCE! KAISER ALUMINUM

Steam turbine buckets of maximum efficiency are made on this tape-controlled profile miller.

Large steam turbine triple play... from drawing to tape to bucket

At General Electric, turbine buckets with airfoil contours of maximum efficiency are automatically milled to exact tolerances. One result: Increased efficiency with more power from more compact steam turbines.

This high-speed precision production is accomplished with a tape-controlled profile miller. A drawing is translated onto magnetic tape and the tape fed into the milling machine's tape reader. The machine, fully automatic, mills each bucket to identical tolerances.

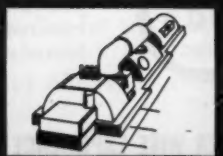
The numerically controlled profile miller is just one of the many precision machine tools used by General Electric to produce the best turbine-generators possible. Other automatic equipment is used for drilling, boring, welding, reaming, tapping, and assembly.

All of these many operations characteristic of modern manufacturing contribute to the quality and performance of each General Electric steam turbine-generator long before it is placed in service. And this quality and performance remain for the many years of each unit's life. 244-10

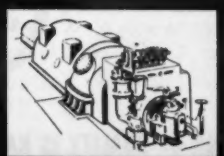
Progress Is Our Most Important Product

GENERAL ELECTRIC

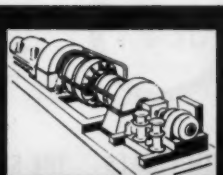
General Electric Turbine-Generators Help Keep Power Costs Low



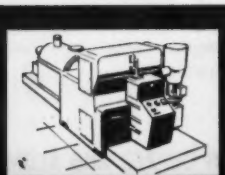
Steam turbine-generators for large blocks of power



Steam turbine-generators 100,000 kw and lower



Gas turbines for peaking, base load, combined cycles



Mechanical drive steam turbines for auxiliaries

Electrical World

AUGUST 14, 1961

Management Newsletter

Pricing the Growth Utilities—Part I

On Wall Street, a quiet, polite debate is taking place. The argument is seldom heated, and each spokesman begins his presentation by lauding the qualifications and ability of his opponents. But despite the resemblance to an academic controversy, the current debate among security analysts is very real, and to the utilities, quite important. The subject is the growth utilities . . . the question at issue: Are they over-priced?

There are many points of agreement between the two camps. Both sides agree that there is such a thing as a growth utility, a point which in itself might have been the subject of a debate only a few years ago. Both sides offer ample evidence to prove that the performance of these utilities has been nothing less than phenomenal.

Tri-Continental Corp, which takes the bullish side of the debate, offers its own utility portfolio for comparison against the Dow-Jones industrial average. If you take 1938 as a base year, and let it equal 100, the Dow-Jones industrials stand at the 400 level at the end of 1960. The Tri-Continental portfolio, on the other hand, passed the 400 level in 1949. Since then, it has climbed steadily to a 1960 level of better than 1,900.

Of course, this is a carefully selected and well-managed portfolio. It could be argued that such performance is in no way typical of the growth utilities. But

from Francis I. duPont & Co comes another study. And although duPont takes the more conservative side of the debate and is clearly in a camp hostile to the Tri-Continental views, nevertheless it supports the view that the growth utilities have indeed outstripped the industrials.

The duPont study uses a growth utilities average which, the company carefully points out, is a representative average including "several, but by no means all of the most spectacular performers." As a base year, duPont chooses 1951 and rates both its own "growth utilities average," and the Dow-Jones industrial average at 100 for that year. By 1960, the Dow-Jones industrials had climbed to 242. But the "growth utilities average" had reached 463, nearly twice the industrial level.

Both these studies lead to the same conclusion. The concept that utilities are primarily defensive in nature, and that regulation means a more modest appreciation of value, is dead. Some utility shares have badly beaten the performance of industrial stocks, and these are the utilities which have earned the title "growth utilities."

The two parties to the debate agree that many utility commons are growth investments. They agree also that when all the factors are weighed, the future of the utility industry is anything but gloomy. But this is only the background for a far larger area of disagreement. When it comes to the current prices of these growth utility shares, the cordial security analysts politely polarize. One group examines the facts and concludes that the growth utilities are over-priced. The other not only denies this contention, but insists that the growth utilities are underpriced.

It should be noted at the outset that this is not a controversy between the established experts and a new and noisy avant garde. Respected names with mature reputations are found on each side of the fence.

The basis for the controversy seems to be in the point of departure; in the very method of analysis itself. One group feels that the proper price of a security should be based on earnings foreseeable in the future. The rate of increase of such earnings, it argues, should be estimated on the basis of an examination of past performance. This group would then separate utility commons from the shares of other industries, study their history, and project that history for a reasonable period into the future. Since this analysis follows the utilities from the past, through the present, and into the foreseeable future, we might call it "vertical" analysis.

The second school rejects this type of analysis. It argues that the only truly relevant time period for evaluating the proper price of a share is the present. And it insists that utility shares must not be viewed in a vacuum, but rather as part of a securities market which includes industrials and rails as well. How, it asks, are utilities priced when compared with other securities of similar earnings? This group is taking only one period of time and viewing utilities against the total securities market. Such an approach can be called "horizontal" analysis.

Next week's Management Newsletter will discuss the arguments advanced by the horizontal school. This letter will discuss the vertical type of analysis.

Proponents of a vertical analysis begin with the assumption that the value of a utility common stock is based on an estimate of future earnings. The investor, they say, is not buying a lottery ticket. He is buying a security in hope of a return in the future. What he pays should be determined by what he expects that return to be. If the value of a share is increasing, then its appreciation represents real value to the investor. Hence, what the investor wants to know is what will be the earnings of the share in the future, and what price should he pay for a present claim on these future earnings.

Clearly, the vertical analysis continues, we cannot accept a brief history of high price-earnings ratios as indicative of a proper price. The market judgment at one point in time cannot be construed as an indicator of normal levels. Hence, we must ask what can we expect the "normal" price to be for a given rate of growth in earnings.

To determine "normal" performance, analysts of this school study the past performance of utility commons. One such study, developed by a leading brokerage house, examines utilities' annual growth rates, and price-earnings ratios which the market has generally associated with these growth rates. From 1935 to 1959, a price-earnings multiplier of 14.4 was found to have been normal for a utility increasing earnings by 5% per year. Shortening the period of inspection to cover 1955 to 1959, a multiplier of 15.6 runs with a growth rate of 5.4%. This study concluded that, historically, the market has associated a multiplier of 14 or 15 with a 5% annual growth in earnings per share.

Currently, however, utility shares are selling at far higher price-earnings ratios. Moody's Electric Utility Average, for instance, is priced at a little better than 21 times earnings, and a recent compilation listing 111 actively traded issues showed that 30 utilities were selling at better than 25 times earnings. Certainly, these high multipliers are not going to drop to the historical multiplier level overnight. Thus, some weight must be given to the present high levels in deciding what will be normal for the foreseeable future. For this reason, the brokerage house conducting the study concludes that 18 may well be a normal future multiplier for a utility with a 5% annual growth in earnings per share.

Is a multiplier of 18 reasonable? Apparently many investors feel it is. At a recent gathering of senior representatives from 39 institutional investors, the question was posed, "What earnings multiplier should we associate as a normal figure with a utility growing at 5% per year?" All those present felt the figure should be higher than 16. One-third of the representatives felt the multiplier should be 18 or higher. Three felt it could well be over 20.

Those who use this type of analysis may differ slightly on their "normal" multiplier. But whatever figure they do arrive at can then be used to establish a mathematical correlation between price earnings ratios and growth rates. Such a correlation will take each growth rate and assume that this rate continues for a number of years. At the end of this period, it is assumed that the growth rate will return to the industry average of about 5% per year. Thus, for any growth rate which is above the industry average, the longer it is expected to continue, the higher the price-earnings ratio which is justified. If we accept the multiplier of 18 as normal for a company increasing its per share earnings by 5% annually, then we might refer to a correlation developed by Charles Tatham of Bache & Co.

Annual Increase In Per Share Earnings	5 Yr.	7 Yr.	10 Yr.	15 Yr.	20 Yr.
2%	15.7x	15.0x	14.0x	12.6x	11.3x
4	17.2	17.0	16.6	16.0	15.4
5	18.0	18.0	18.0	18.0	18.0
6	18.8	19.0	19.6	20.4	21.2
8	20.5	21.4	23.1	26.0	29.2
10	22.3	24.1	27.2	33.0	40.0
12	24.2	27.1	32.0	42.1	55.7
14	26.4	30.3	37.7	53.5	76.0
16	28.6	34.0	44.2	68.0	106.0

In the vertical analysis, a correlation of this type helps provide the answer as to the level at which a utility share should be priced. Take, for example, an outstanding growth situation which has increased earnings at an annual rate of 12%. Current earnings look as if they will follow the trend with this year about 12%

ahead of last year. Currently, the stock is selling at about 35 times earnings. Is the price too high?

According to this analysis, and the correlation that goes with a normal multiplier of 18, the price-earnings ratio of 35 to 1 is justified for a 12% annual increase in earnings only if this 12% is apt to continue for better than 10 years. Otherwise the investment will be returning less to the investor than he could have gotten by purchasing a 5% growth situation at an 18 to 1 price-earnings ratio.

Of course, in practice, the process is not quite so simple. The analyst must vary the correlation to meet individual situations. A company may be earning a 5% increment now, but may promise a 7% increment next year. This would call for special consideration. And deciding just how much a company will add to earnings in a given year is not a decision that can be read from a table or a slide rule. It takes fine judgment and years of experience. But this is the basic method of a vertical analysis. You establish a range of "justified" price-earnings ratios, and use these as bench marks in evaluating a given stock.

Many of today's growth utilities are greatly over-priced, according to analysts using this line of approach. To justify current ratios, some of which are flirting with and even exceeding a multiplier of 40, you have to assume that these high earnings will continue for 12, 15, sometimes 20 years into the future. Such purchases, these analysts argue, cease to be investments. They become a wager made on future events which no one can possibly foresee.

Some analysts devote much attention to studying an individual electric utility's future. Is it blessed with a favorable regulatory climate? Is it threatened by public power projects? Is its territory only beginning to develop? Is its management young? By evaluating these problems, the analyst hopes to find how long high earnings can be expected to continue.

But others of the profession feel that such examination is pointless. Regulatory climate can change overnight, they argue. There's just no way of knowing. Similarly, management attitude can change with the retirement of one or two key men, or with the untimely departure of a younger officer. Once you get five years into the future, you're dealing with unknown quantities. Investors should not be asked to put up their money on the basis that these unknowns will all turn out to be favorable.

If you accept the basic logic of the vertical school, the conclusions it reaches are inescapable. Current prices for the growth utilities, on the average, are a good deal too high. Even though the future looks bright, the brightness is based more on mental attitude and less on facts as you move further into the future. Current prices reflect wishful thinking rather than sound investing.

Individual analysts of this school vary in their opinion of what this over-pricing means for the future. No one expects the bottom to fall out of utility prices. This isn't the nature of the animal. Some say they may settle a few points. Others expect them to hold at about the current level and let earnings catch up with price. There is also a forecast for moderate increase in price, but at only a fraction of the rate which occurred during the past decade, and particularly during the past few years. The past few years, they say, have been abnormal. Future investment will tend to correct this situation.

But before you accept this argument completely, remember that there is another school of thought. Security analysts who take the horizontal approach accept most of the vertical argument. They agree that its mathematics are flawless, and the integrity of its advocates beyond reproach. Only trouble, they say, is that the entire argument is irrelevant. We'll review their argument in next week's Management Newsletter and see why they think growth utilities are under-priced.

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All-hydraulic speed governing for steam turbines

By N. K. Halsteen, Project Engineer, Brown Boveri Corp.

BROWN BOVERI

Brown Boveri was first to develop and use hydraulic speed governing . . . with patents as early as 1906. The all-hydraulic system eliminates rods, levers and mechanical linkages which, through thermal expansion, wear and excess play, interfere with reliable, sensitive speed control.

The hydraulic system also allows design refinements involving hydraulic relays and servomotors for amplification of control impulses . . . without any mechanical linkage.

Modifications have adapted the governing system to modern reheat units of all sizes.

Description of system

Fig. 1 shows the Brown Boveri governing system for units without reheat.

The main oil pump supplies oil at approximately 70 psi to bearings and as an operating medium, to the power pistons of the nozzle valves. At reduced pressure it also supplies oil to the emergency and governing oil systems. At start-up, the emergency oil system is actuated first and opens the main stop valve. Then the nozzle valves open in sequence via the governing oil system and relay pistons.

If shaft speed is increased by a reduction of load, the spring-loaded centrifugal speed governor opens a port that reduces pressure in the governing oil system and thus closes the nozzle valves. (This port is also controlled manually or remotely for paralleling units or altering load distribution.)

Operated by a single handwheel, the starting gear controls both the emergency and governing oil systems and thereby the valve positions. At the preset limit for overspeed, the overspeed governor causes the starting gear to rotate instantly to shut-down position, depressurizing the oil systems.

Nozzle valves are double seated for balanced operation at relatively low oil pressures. Relay springs are of stepped tensions – to open valves in preset sequence.

The overspeed test screw (not shown) introduces oil under pressure to replace centrifugal force – allowing tests of overspeed governor and shut-down system at normal speed. Other valves test the main stop valve and nozzle inlet valves (at no load).

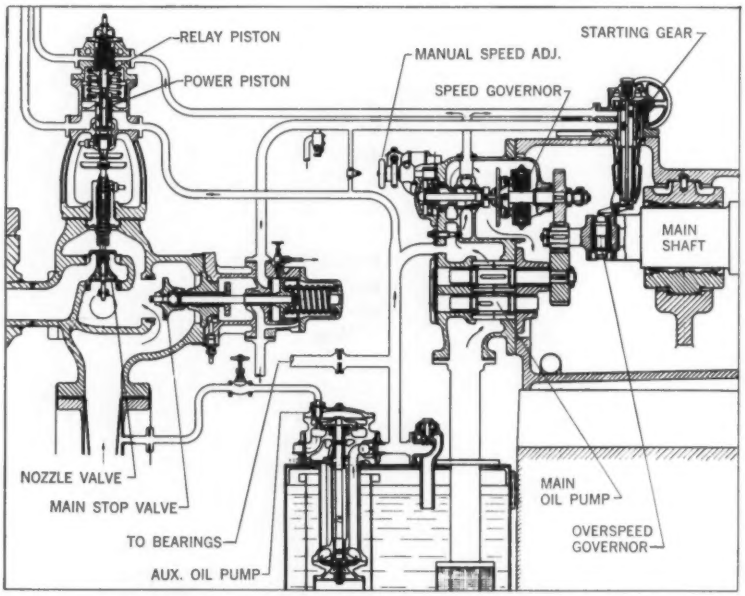


Fig. 1 Linkage-free pressure oil governing system with relay-operated nozzle valves.

Modifications for large reheat turbines

To eliminate the fire hazard introduced by very high steam temperature, non-combustible fluid is used in place of oil for the speed-governing system. Oil, with separate tank and pumps, is used for lubrication only.

A pressure-gradient relay controls the interceptor valves between reheater and ipt turbine – to avoid undesirable temporary speed deviations at sudden load change. Fig. 2.

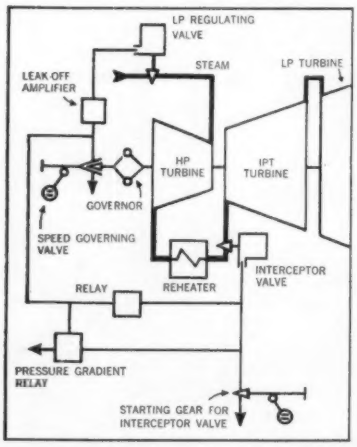


Fig. 2 Principle for speed control of Brown Boveri reheat turbines.

Single-seat nozzle valves are used with high pressure valve control fluid (approx. 400 psi.)

When governing oil pressure drops rapidly, the leak-off amplifier opens a drain port in the valve control oil line . . . shortening closing time for the nozzle valves.

Advantages of Brown Boveri speed-control system

Highly sensitive speed control without "hunting." No mechanical play. Short, compact piping. Almost negligible wear since valve pistons and other critical parts operate in oil.

Positive bearing protection with oil pump driven by turbine shaft. No booster pump required. Double overspeed protection with two overspeed governors on larger units and simple testing of shut-down systems.

No governing-oil fire hazard. No expensive double-guard pipe and fittings for governing fluid.

Minimum throttling losses and symmetrical heating through advanced nozzle design and control.

BROWN BOVERI Brown Boveri Corp., Dept. EW8, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities

Promotion Racks Up Over 400% of Quota

Follow-up of utility refrigerator-freezer campaign shows over 3 million kwhr added to residential load

The proof of a utility's promotion pudding is in the added power load. With this version of an ancient adage in mind, Fred Ellenberg, residential and farm sales director, Atlantic City Electric Co, took a preliminary sampling of the kilowatt consumption of residential customers who bought electric refrigerator-freezers during the ACE campaign in June and July, 1960 (EW, Aug. 22, 1960, p 94-96).

The promotion produced 2,457 sales of refrigerator-freezers and freezers in six weeks—more than 400% of quota. The campaign theme was "An Electric Refrigerator-Freezer Is a Supermarket in Your Kitchen," and tied in with the National Electrical Manufacturers Assn national promotion.

To dramatize the "Supermarket" theme, the utility offered buyers of authorized units a $25 food bonus, redeemable at participating markets.

In addition, ACE gave dealer salesmen $5 for each sale, bringing to $30 apiece the bonus outlay for each unit sold, not counting the regular promotion and advertising costs of the campaign.

The utility felt its expenditures would be justified by the increase in revenue. NEMA had cautiously calculated the typical refrigerator-freezer sold today (about 13 cu ft) used an average of 800 kwhr per year more than the typical 8 to 10-ft model sold five years ago. ACE thought the figure too conservative and looked for an average increase of 1,000 kwhr per customer.

The actual increase, based on a random sample of 50 Atlantic City purchasers of electric refrigerator-freezers was 1,270 kwhr a year. Furthermore, the figure was arrived at on the basis of seven months bills from September through March, excluding the hot summer months of greatest refrigerator use.

Summing it up, Ellenberg said, "After the campaign we figured we added about 2,457,000 kwhr a year to residential load. Now it looks more like three million and some.

"Our expectations were more than justified. At our average .0272 rate, we're liquidating the food giveaway and salesmen's bonus costs in the first year the refrigerator-freezers are in service."

Was it possible some of the increase was due to other appliances added to the lines? "In some cases, undoubtedly yes," Ellenberg said. "But we think 50 cases taken completely at random are a valid sample. One factor that probably helped boost load was that a lot of people kept their old refrigerator, and kept it running. We encouraged that idea during the campaign, which is one reason we preferred giving a food bonus rather than underwrite a trade-in program."

Was the increase due largely to a preponderance of no-defrost models?

"No," Ellenberg commented. "Some people, even in our industry, have the misconception that the frost-free feature notably builds up kilowatt consumption. Our dealers did sell many frost-free models, but the real reasons for the great per-unit load increase are that the average refrigerator-freezer sold today is about five cubic ft larger inside than the average one-zone refrigeratons sold a few years ago, and a considerable portion of it is freezer space."

The Atlantic City Electric campaign created considerable stir throughout the industry. After its results were reported in *Electrical World,* Ellenberg received many letters from utilities asking for information on how he set up the campaign and for samples of advertising and promotional literature.

One Canadian utility sent a representative to Atlantic City to talk to Ellenberg, then based its own refrigerator-freezer campaign on the Atlantic City model.

The Atlantic City kit included a letter to dealers outlining the food bonus plan, a sample food gift certificate, display streamer and consumer direct mail material purchased from NEMA, and a list of electric refrigerator-freezers and freezers, by manufacturer and model number, which qualified for a bonus. Only units with true zero temperature zones—all substantial load builders—were listed.

Some 225 authorized dealers participated, a number of them matching the ACE bonus with an additional $25 offer to the customer. Others added other kinds of incentives, such as a dealer who gave a supply of asparagus from his own farm. Many dealers displayed a top-of-the-line refrigerator in co-operating supermarkets.

All ten members of the Household Refrigerator and Freezer Section of NEMA tied into the campaign, giving co-op ad allowances.

Bill Limits Utility Merchandising

Legislation which will just about knock Nebraska's publicly owned electric and gas utilities out of the appliance sales field has been passed by the Nebraska State Legislature.

LB 578 forbids public power agencies from selling appliances valued at more than $50, and LB 721, also containing the $50 proviso, was amended to permit the Metropolitan Utilities District, only publicly owned gas utility to sell new gas appliances for seven years.

This refers primarily to gas-fired window air conditioners and signals a partial victory for MUD, which had argued that this "infant" appliance would die for lack of dealer support.

LB 721 allows MUD to merchan-

dise any new appliance until such time as 25% of the market is saturated or the product has been marketed for seven years.

Effective date for both bills is Jan. 1, 1963.

Basic contention by proponents of the measures was that the publicly supported districts are competing with private enterprise, using vast financial resources to promote sales that should be chalked up by the dealers.

Chief retort by opponents was that their promotional and sales activities spurred consumer interest, and that these activities are needed to build consumption in seasons when electrical or gas consumption is at low ebb. To curtail or prohibit these activities will ultimately be reflected in higher gas and power rates to consumers, they said.

Specifically, R. L. Schacht, Consumers Public Power District general manager said, "CPPD sells appliances as a load-building activity. Like street lighting, electric heating and other residential, industrial or commercial uses of electrical energy, the sale of electrical appliances is a means of increasing our load so as to absorb the constantly increasing costs of operations and thus avoid rate increases.

"CPPD directs its promotional efforts to the sale of electrical appliances, whether by Consumers or any other appliance dealer," he continued. "The utility maintains prices at a level where the dealers have no difficulty in competing for sales."

Among the utilities which will bear the brunt of the legislation are Metropolitan Utility District, which displays and sells most types of gas appliances at its headquarters building, and Consumers Public Power District. Omaha Public Power District promotes but does not sell appliances at retail.

Cooking School Draws Praise From Attendees

EEI-sponsored classes for electric cooking sales personnel stress food preparation and equipment merchandising

Thirty-eight men from 27 utility companies, as far away as Florida and Arkansas, attended the first Edison Electric Institute Commercial Electric Cooking School held recently in New Haven, Conn.

The school was designed especially for electric utility sales personnel who contact food service operators. The course featured the fundamentals of quantity food preparation, use of food preparation equipment, and various aspects of electric cooking equipment merchandising.

The sessions were held at The Culinary Institute of America and the school faculty was from the regular faculty of The Institute which includes noted chefs and bakers with experience at famous American and European hotels and restaurants.

In addition to actual cooking and baking done under the supervision of the chefs and bakers, the students also attended lectures dealing with merchandising, observed culinary demonstrations and participated in panel discussions with equipment manufacturers' representatives, food service executives, architects and sales executives.

A press release was sent to hometown papers of the men attending the school telling of their part in the course.

A questionnaire filled out by all who participated indicated wholehearted support for the school's purpose. When asked if they would recommend the school for others in their organization only one man said "no." And his reason was, "I can't, I'm the only person who contacts food service people."

To the question, "How do you specifically propose to utilize the information you gained at the Culinary Institute?" one attendee said, "As a means of training the food service salesmen in our company, and as a means of increasing my own prestige with customers."

Another said, "It will help me greatly in the training of commercial cooking salesmen in the field. It will also help me greatly on jobs where I am called in as a consultant."

CHEF from Culinary Institute of America shows attendees at the EEI cooking school some of the fine techniques in food preparation

Iowa Utility Boosts Dows To Chairman

DOWS ARNOLD DOWS JR SMITH

Iowa Electric Light & Power Co has elected Sutherland Dows chairman and Duane Arnold, president. Sutherland Dows Jr and Stevan B. Smith were appointed vice presidents.

Dows Sr, who has been president since 1941, will continue as chief executive officer. Arnold moved up from the position of vice president and general manager, which he has held since 1954.

Dows Jr, formerly general commercial manager, will be in charge of the commercial department. Smith, most recently assistant secretary, will be in charge of real estate and insurance matters.

GE Gives VP Parker New Duties, Names Day Vice President

PARKER DAY

General Electric Co has promoted Jack S. Parker to vice president and group executive in charge of the electronic and flight systems group and has named Virgil B. Day vice president in charge of relations services. Robert E. Pfenning was appointed comptroller.

Parker succeeded Cramer W. LaPierre, newly elected executive vice president and director. Pfenning replaced Gerald L. Phillippe, recently elected GE president and director (EW, Aug. 7, p 28).

A vice president since 1956, Parker has been vice president-relations services for the past four years. Day has been public affairs service manager for two years.

Reynolds Boosted to VP By Leeds & Northrup Co

REYNOLDS

Alexander H. Reynolds Jr has been elected a vice president of Leeds & Northrup Co. He will be responsible for long-range planning. Stephen Loidl Jr became treasurer and controller, directing all financial department operations.

Frenzel Becomes Manager

Industrial battery sales division of Gould-National Batteries, Inc, has promoted E. J. Frenzel to the position of utility power applications manager. Frenzel has been with the company since 1945, most recently as special accounts manager (Chicago district).

Linde Named Engineering Director of A-C Group

Allis-Chalmers Manufacturing Co has named Leonard J. Linde engineering director, industries group. He is in charge of the administration, review and coordination of the group's research and development. Linde has been with the company since 1950.

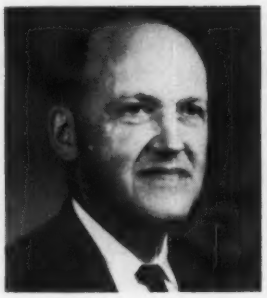
Sales Post Given to Wall

Electric Machinery Manufacturing Co, Minneapolis, Minn., has named James J. Wall Jr general sales manager.

Jury Promoted by Graybar

V. R. Jury has been appointed transmission sales manager by Graybar Electric Co, Inc. He will be located in Chicago.

San Diego G&E Elects Knerr Vice President



KNERR ▶

Lewis R. Knerr has been elected vice president-management services at San Diego Gas & Electric Co.

In addition to his duties as rates and valuation manager, Knerr assumed administrative and management functions relating to employee relations, purchasing, insurance, safety and claims.

Knerr has been with San Diego G&E since 1956. Prior to that he was a consulting engineer for two years. He has held engineering positions with Great Western Power Co and Pacific Gas & Electric Co and served in various capacities with the California Public Utilities Commission.

PERSONAL BRIEFS

C. Perry Griffith has been promoted to administrative assistant for public relations at Indianapolis Power & Light Co. **William I. Spencer** succeeded Griffith as treasury service supervisor.

At Consolidated Edison Co of New York, Inc, **Robert O. Babcock** has retired as manager of the transportation department. **Hugh Stewart,** executive engineer at San Diego Gas & Electric Co, has also retired.

Pacific Gas & Electric Co has promoted **Albert B. Cook** to commercial manager, succeeding **R. W. Joyce.** Joyce was recently named vice president in charge of commercial operations (EW, July 3, p 77).

Duquesne Light Co has boosted **H. L. Murphey Jr** to manager of the newly established public affairs department, and **John P. Schmidt** to director of the new department.

Bechtel Corp has established an organization in Australia and New Zealand. **W. E. Arthur,** vice president and managing director of Bechtel Pacific Corp Ltd, is senior resident officer.

Eugene Fioramonti has been elected vice president of Powertron Pacific Corp, West Coast subsidiary of Powertron Ultrasonics Corp.

P. R. Mallory & Co, Inc, has placed **Harold C. Buell,** vice president, in charge of customer relations.

Minneapolis - Honeywell Regulator Co has established a programming systems division within its electronic data processing division. **Dr Joseph H. Levin** is director of the new division. **Raymond S. Fries** became manufacturing and engineering manager, Brown instruments division.

OBITUARIES . . . **Vincent T. Miles,** 57, former treasurer of Long Island Lighting Co . . . **Edwin A. Harris,** 75, retired Norwalk division manager, Connecticut Light & Power Co . . . **George Campbell Sr,** 77, retired apparatus division manager, General Electric Co . . . **Lester W. Evers,** 55, former assistant vice president with Hubbard & Co and more recently associated with Joslyn Manufacturing & Supply Co.

240/480-V Design Cuts Cost of UG Distribution (*Continued from page* 77)

tensive use of underground distribution. Subdivision C, with a relatively large number of lots, somewhat resembles Subdivision A and shows relatively low distribution costs.

Subdivision B is less typical, as it includes relatively few lots in hilly terrain. Most of these face a park, and a large part of the required distribution can serve but a single row of homes. Subdivision D, comprising a relatively small number of lots, also incurs the high cost of distribution to serve a single row of homes. These two cases illustrate the importance of promoting subdivision planning which will permit economical electrical distribution.

When underground systems are credited for elimination of tree trimming and reduction of losses, the cost differential is materially reduced. Tree trimming for overhead residential distribution is estimated at $2.00 per lot per year. And the savings in losses is rather appreciable, especially for the higher-voltage system. Thus the total annual cost per lot of the underground 240/480-v system for Subdivision A, shown in Table II, is below that of 120/240-v underground distribution and only 6.7% higher than conventional overhead distribution.

Operation of major fixed appliances at 240 v to ground does not appear to conflict with the National Electrical Code. Neither does use of 240/480-v 3-wire services as long as the branch circuits do not exceed 240 v. But local inspection authorities should always be consulted to avoid contrary opinions and code-making groups should refrain from adopting revisions which would restrict use of the higher-voltage system.

Today's electric water heaters and space heating equipment can be operated at 240 v to ground with only minor changes. But ranges and clothes dryers pose somewhat more difficult problems which must be solved before they can be provided for 240-v operation at the cost of present 120/240-v models.

277/120-V Busway

(*Continued from page* 71)

through the warehouse area.

A cost comparison was made of these three lighting distribution schemes:

Scheme A—Conventional wire and conduit for supplying the very high output fluorescent fixtures from conventional 120/208-v lighting transformers; lighting cabinets with 110-v outlets at 5-ft intervals to supply miscellaneous power.

Scheme B — Factory-prefabricated wiring troughs for support of lighting fixtures with 277-v from lighting transformers, with separate 110-v outlets at 5-ft intervals.

Scheme C—A 277/120-v 3-wire busway system.

Our study and actual installation found Scheme C to be the most economical. The installed cost has been sharply reduced to $0.73 per sq ft for a 75-ft-c maintained plant lighting intensity. For the plant lighting installation, modified roller hangers were used, complete with airplane messenger wire for side tension control. Welded Nelson studs secure the roller hangers at 5-ft intervals. Roller hangers were installed with a truck-mounted boom operated by pushbutton control. Two men can install a 510-ft roll of roller hangers and supports in 1½ hr.

A pushbutton-controlled chain-operated conveyor-type of hoist raised the luminaires 16 ft to the point of installation. Index cards were used to instruct the ground force for assembly of the whole system at ground level, including preparation of fixtures, bus ducts and feed boxes.

The lighting system was energized for construction use. Field supervision closely followed these procedures and coordinated the lighting installation schedule with concrete floor work. Plant construction was successfully carried out through the winter and the job was completed ahead of schedule.

Inspectors Will Meet

The International Assn of Electrical Inspectors, Eastern Section, will hold its annual meeting at the Warwick Hotel in Philadelphia Pa., on Oct. 9-11.

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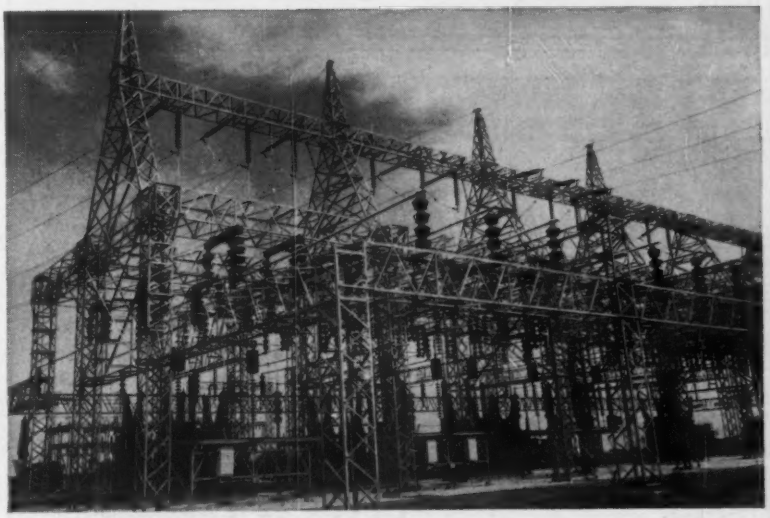

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ADDRESS BOX NO. REPLIES TO: Box No.
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Three Chief Operators with Public Utility experience for 80,000 KVA Hydroelectric Plant in East Pakistan. One year contract at $1000 per month with subsistance, housing and transportation furnished. All qualified applicants will be considered without regard to race, creed, color or national origin. Send resume of experience to Utah-Pakistan Inc., 221 Pine Street, San Francisco, California.

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Power Plant Operators—Require Chief Engineer and Assistant Chief Engineer (minimum 10 years experience) for operations assignment in new 20 MW oil fired plant located at Tripoli, Libya. Also three (3) Shift Foremen, one (1) Maintenance Foreman and one (1) Plant Technician. Six month contract with possible extension. Services required about 15 September 1961. Good working and living conditions. All replies treated in confidence. Address Gilbert Associates, Inc., Attn: R. W. Roughton, Box #1498, Reading, Pa.

POSITION WANTED

Power Plant startup Engineer, age 39, experience in High Pressure Steam Power Plants and training of operators. Desire supervisory position. PW-7243, Electrical World.

U. S. Government

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5646) will be received at Denver, Colorado, until 2 p.m., Mountain Standard Time, September 21, 1961, for furnishing one, 15,000-kva, 132 to 34.5-kv, 3-phase, Class OA, power transformer for Heyburn Substation, Minidoka Project, Idaho. Delivery is desired within 220 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colorado. Floyd E. Dominy, Commissioner.

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5647) will be received at Denver, Colorado, until 2 p.m., Mountain Standard Time, September 19, 1961, for furnishing nine (9), 230-kv. 20,000,000-kva, 1,600-ampere, oil or air-blast types only, power circuit breakers for Tracy Switchyard, Central Valley Project, California. Delivery is desired within 300 to 360 days. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colorado. Floyd E. Dominy, Commissioner.

OFFICIAL PROPOSALS

Bids: September 5, 1961

U. S. A. E. C.

Brookhaven National Laboratory

Sealed bids for supplying seven 112½ KVA Distribution Unit Substations for High Flux Beam Reactor Project, U. S. A. E. C. at Brookhaven National Laboratory, Upton, Long Island, will be received by The Lummus Co. 146 Haynes Ave. Newark, N. J. until 2:30 PM EDT, Sept. 5, 1961 and publicly opened at the above address. Specifications and bid forms may be obtained at The Lummus Co. without deposit.

TRANSFORMERS

3—2500 KVA G-E 69000—2400/4160Y
3—2500 KVA G-E 69000—7200/12470Y
4—2500 KVA W-H 34500—2400/4800
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y
3— 500 KVA A-Ch 2400/4160Y—240 x 480
3—500 KVA A-Ch 7200/12470Y—240 x 480
3— 500 KVA A-Ch. 13200—240 x 480
3—1000 KVA G-E 34500-7200/12470Y
3—1000 KVA Wag. 34500—2400/4160Y
3— 833 KVA W-H 43800—480
3— 500 KVA Penn. 13200—120/240
3— 333 KVA W-H 13200—2400/4160Y
3— 333 KVA G-E 2400/4160Y—240/480
3— 333 KVA Wag. 2400—120/240
1—1500/1875 KVA Mol. 3-Ph. 34,500—2400 F/C equipped

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SUBSTATION EQUIPMENT

TRANSFORMERS

QU.	KVA	MFG.	VOLTAGE
1	12000	G.E.	115,000—46,000 L.T.C.
1	10000	West.	67,000—34,500, 3 Ph. Auto.
1	7500	West.	66,000—13,800, 3 Ph.
1	7500	West.	66,000—2400/4160, 3 Ph.
1	3750	G.E.	69,300—13,200, 3 Ph.
1	3000	G.E.	69,000—4340, 3 Ph.
6	1667	West.	66,000—2300/4000
6	750	Wagner	66,000Y—13,200
4	333	West.	67,000—7200/12470Y
2	2500	Wagner	45,000—4160Y, 3 Ph.
1	5000	West.	34,500—13750/6875, 3 Ph.
1	4500	West.	33,000—2500/4330, 3 Ph.
3	3333	Penna.	34,500—6900/11950Y
2	3000	Upgf.	34,750—4160, 3 Ph.
2	1500	G.E.	34,400—2520, 3 Ph.
3	1250	A.C.	33,000—480
4	750	Wagner	33,000Y—6900
3	500	Mol.	34,500—2300/4600
3	200	A.C.	34,500—2400/7200/12470Y
1	3750	West.	22,900—4160Y, 3 Ph.
2	3000	G.E.	13,800—2640, 3 Ph.
1	2500	G.E.	13,800—2400, 3 Ph. Unit Sub.
3	667	G.E.	13,200—240/480
1	600	Stand.	13,200—2300, 3 Ph.
1	450	Penna.	13,200—2400, 3 Ph. Askarel
1	4500	West.	7,245—2300, 3 Ph.
1	1500	Wagner	4160/2400—600, 3 Ph.
1	1000	A.C.	2400/4160—240, 3 Ph.
3	167	West.	2400/4160—240/480

FREQUENCY CHANGERS

1	4600 Kw, 60 cycle, 13800 volts, Generator 6500 Hp, 25 cycle, 11000 volts, Motor—300 Rpm
1	2500 Kw, 25 cycle, 2400 volts, Generator 3500 Hp, 60 cycle, 6600 volts, Motor—300 Rpm
1	2000 Kw, 62½ cycle, 2300/4000 volts, Generator 2800 Hp, 25 cycle, 2300/4000v, Motor—750 Rpm

Also: CIRCUIT BREAKERS, SWITCHGEAR, FEEDER REGULATORS, M-G SETS, ETC.

BREW, WOLTMAN
& CO., INC.
52 Church Street, New York 7, N. Y.

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Must be a graduate electrical or mechanical engineer and have a minimum 5 years experience in the design of high voltage air break switches. Excellent salary and benefits. . . . Please send a complete resume including salary requirements. . . . All replies will be held in strict confidence. Reply to Mr. C. H. Baker, director of engineering

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Meetings Calendar

AUGUST

• **Southeastern Electric Exchange**—Accident Prevention Committee, Sir Walter Raleigh Hotel, Raleigh, North Carolina, Aug. 17-18.

Western Electronic Show & Convention—Cow Palace, San Francisco, Aug. 22-25.

American Institute of Electrical Engineers—Pacific General Meeting, Hotel Utah, Salt Lake City, Aug. 23-25.

American Society of Mechanical Engineers—International Heat Transfer Conference, University of Colorado, Boulder, Aug. 28-Sept. 1.

American Institute of Mining, Metallurgical, & Petroleum Engineers—Third Annual Semiconductor Conference, Ambassador Hotel, Los Angeles, California, Aug. 30-Sept. 1.

SEPTEMBER

Association of Illinois Electric Cooperatives—Annual Meeting, Springfield, Illinois, Sept. 6-8.

Northwest Public Power Association—Power Use Section Annual Workshop, Pacific University, Campus, Forest Grove Oregon, Sept. 6-8.

National Rural Electric Cooperative Association—Region IV Meeting, Columbus, Ohio, Sept. 7-8; Region V Meeting Eau Claire, Wisconson, Sept. 11-12; Region III Meeting, Admiral Semmes, Mobile, Ala, Sept. 25-26; Region I Meeting, Richmond, Virginia, Sept. 28-29.

Rocky Mountain Electrical League—Annual Fall Convention Jackson Lake Lodge, Moran, Wyoming, Sept. 10-13.

Edison Electric Institute—AGA, Accounting Section Organization Meeting, The Netherland Hilton Hotel, Cincinnati, Ohio, Sept. 11-12; Meter and Service Committee, Hotel Leland, Springfield, Illinois, Sept. 24-27; Industrial Relations Committee, Annual Round Table Conference, Drake Hotel, Chicago, Sept. 25-27.

• **Southeastern Electric Exchange**—Power Coordination Committee, Henry Grady Hotel, Atlanta, Georgia, Sept. 12; Accounting Section Conference, Atlanta Biltmore Hotel, Atlanta, Georgia, Sept. 28-29.

Electrical World's Fifth Electric Heating Conference—Sheraton-Park Hotel, Washington, D. C., Sept. 25-26.

• Additions this week.

Taut Band Instrument Aids Metering Task (*Continued from page* 83)

instrument having a resistance as high as 48 ohms would be acceptable. A 1-milliamp taut-band suspension has a resistance of only 13 ohms and an energy requirement only 6.4% that of predecessor instruments. It also provides accurate measurements for a minimum monetary outlay.

The new instrument was selected for the job after other methods had been found impracticable. Initial plans to use millivoltmeters connected in parallel were discarded when laboratory checks indicated that this arrangement required a power output beyond the thermal watt converters' capabilities. Next, milliammeters connected in series were considered. Switchboard instruments then available would also throw too great a burden on the thermal converters to permit accurate calibrations. A typical 1-milliamp meter available at that time had a resistance of about 180 ohms.

Special relay requirements on the 240-kv side of the transformers and the specific location of the potential transformers on the 24-kv side made totalizing by conventional direct metering seem inadvisable. The taut band suspension instrument is proving to be a valuable tool for instrumentation problems which had formerly been very difficult of solution.

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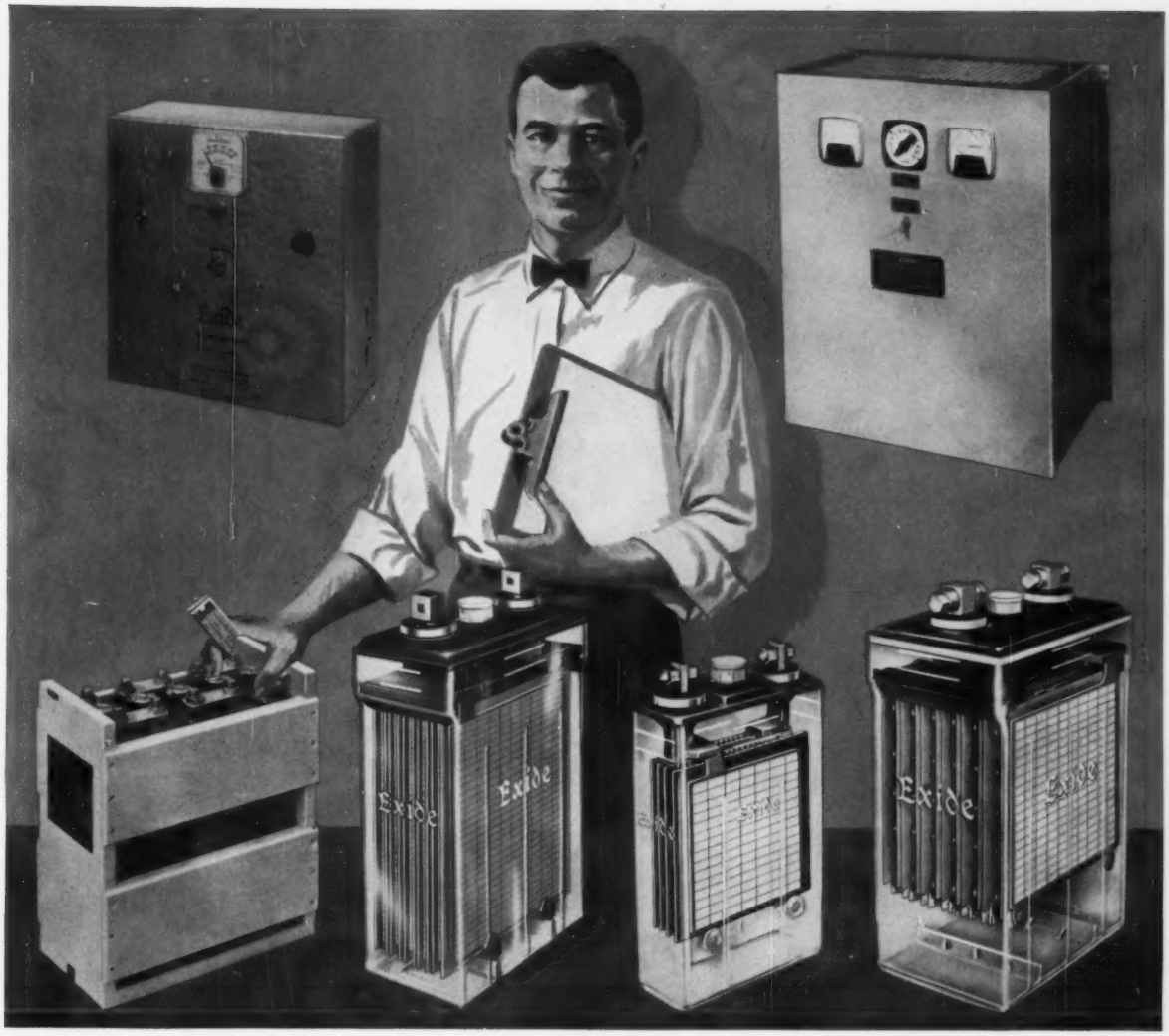

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Selecting a battery and charger today is really an engineering job. Each application has its own requirements. That's why Exide offers a variety of batteries and chargers—in fact the broadest in the field. It means you can buy the type battery and charger you should have. Because Exide has no ax to grind for any particular type, you can expect an unbiased recommendation.

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An Exide power package lets you buy with confidence. Exide service—the quickest, most dependable you can get—covers battery and charger. For complete information, write Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

*Silvium is Exide's patented corrosion-resistant grid alloy

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INDUSTRIAL MARKETING DIVISION (ESB)
The Electric Storage Battery Company

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❶ INSULATED "Quick-Grip" TERMINALS ❷ INSULATED "Celuclad" COVERS

Kuhlman pole-type transformers are fully protected by covered high voltage terminals and insulated covers against any possible service interruption caused by wildlife.

The unique protective design of Kuhlman "Quick-Grip" hand connectors prevents outside contact with all live parts. Thus birds and animals cannot short circuit across the two high voltage terminals or cause a line-to-ground short between terminals and the transformer cover. "Quick-Grip" also adds the convenience of simpler, easier line connections without the use of tools.

"CELUCLAD" COVERS ARE ADDITIONAL PROTECTION

As further protection, Kuhlman transformers are equipped with "Celuclad" insulated covers. The extra heavy "Celuclad" coating provides high dielectric strength and greater weather resistance. It is the same heavy-duty, corrosion-resistant finish furnished by Kuhlman for industrial and salt spray atmospheres.

Only Kuhlman offers the double protection of "Quick-Grip" and "Celuclad." Ask your Kuhlman representative about *all* the many extras which are standard on Kuhlman transformers this year.

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